



ARCHIVES OF

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Archives of Physical Medicine and Rehabilitation

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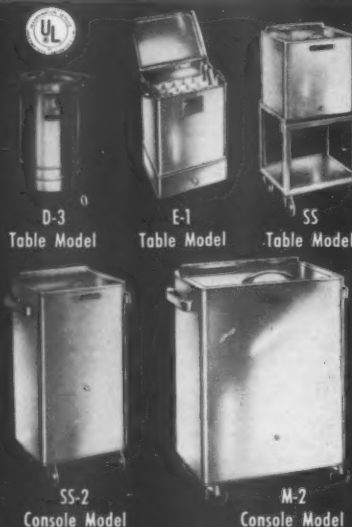


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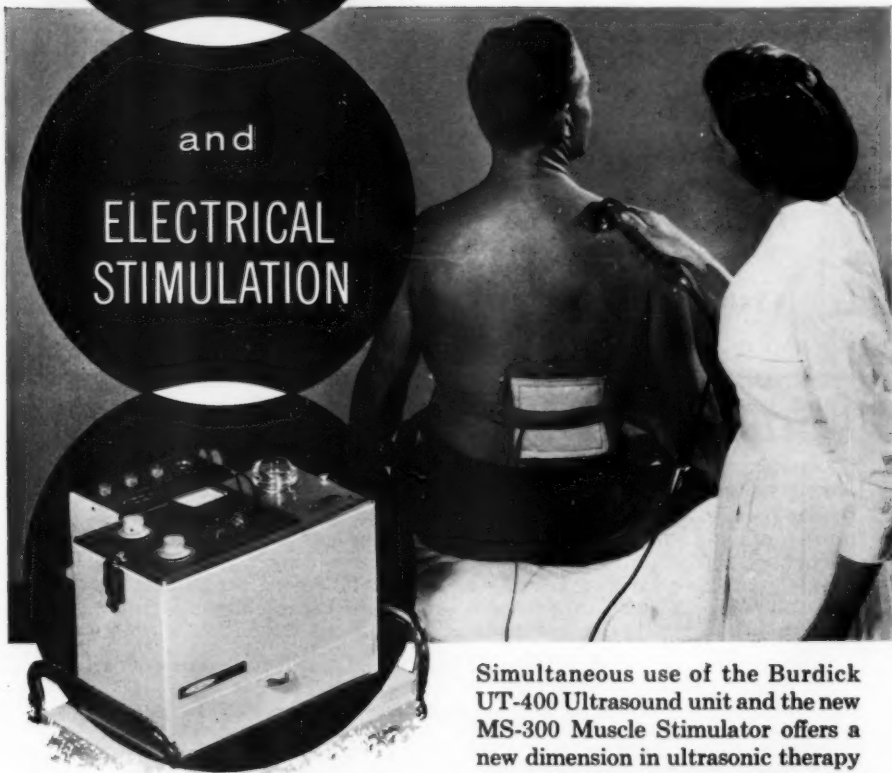
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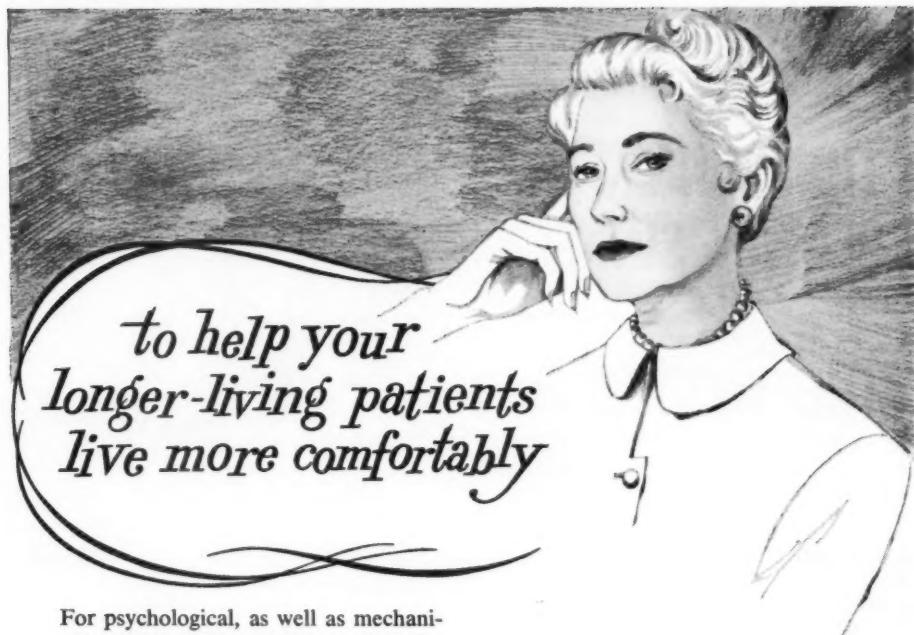
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I've been putting off my vacation for quite some time now . . . about 17 years to be exact . . . but enough is enough! So, last month, I packed up the wife and daughter and hopped on an airliner for Hawaii (my plan had been to go to Ireland and Scotland, but I lost out by a narrow 2-1 vote!).

Well, anyway, we had a wonderful time. My wife and daughter made the ritual trip to Waikiki and the other "tourist traps" on Oahu, but the only contact I had with "civilization" was when I came out of the bush long enough to visit a couple of hospitals.

I really had a most enjoyable visit with Dr. Raoul Psaki, the Psychiatrist at Tripler Army Hospital. He, together with some R.P.T.'s in Honolulu, made me feel quite at home.

And Dr. Kim at Kaiser Hospital was most gracious and charming during my visit. Two friends of mine from Kansas, Dr. Tocker and his fiancée, also are practicing at Kaiser, and introduced me to Dr. Kim, a world-famed cardiologist. One thing, though, that rather struck me, was a little something I saw on the wall of an R.P.T. friend in Honolulu. It made me stop and think about many things . . . and I couldn't help but jot it down so that I

could put it on my wall. I thought you'd like to read it, too.

The Indispensable Man

Sometime, when you're feeling important,
Sometime, when your ego's in bloom,
Sometime, when you take it for granted,
That you're the best qualified in the room.

Sometime, when you feel that your going,
Would leave an unfillable hole,
Just follow this simple instruction,
And see how it humbles your soul.

Take a bucket and fill it with water;
Put your hand in it, up to the wrist;
Pull it out . . . and the hole that's remaining,
Is a measure of how you'll be missed.

You may splash all you please when you enter;
You can stir up the water galore;
But stop, and you'll find in a minute,
That it looks quite the same as before.

The moral is this simple example,
Is to do just the best that you can;
Be proud of yourself . . . but, remember,
There's no indispensable man!

After reading this a couple of times, I didn't feel quite so "guilty" about taking the vacation. I guess it's true for all of us . . . "be proud of yourself, but remember . . . there's no indispensable man!"

Cordially,


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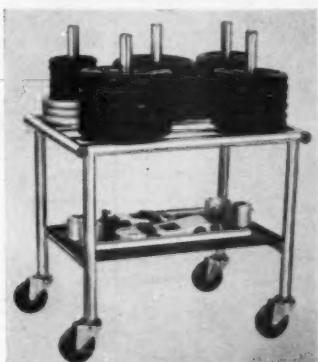
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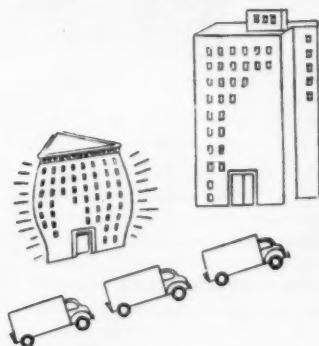
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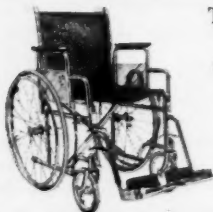
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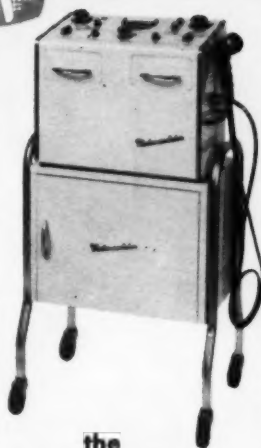


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1. Gordon, E. E. and Haas, A.:
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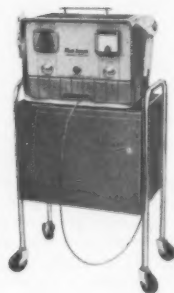


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Electromyographic Kinesiology of the Hand:

Part II. Third Dorsal Interosseus and Extensor Digitorum of the Long Finger

Charles Long, II, M.D.
Mary Eleanor Brown, M.A.
and
Gerald Weiss, M.A.
Cleveland

● Electromyography has made it possible to record the actual function of muscles during normal motion. Several investigators have shown that muscular function at the shoulder, at the elbow, and in the lower extremities does not follow rules inferable from origin and insertion alone. Through the medium of simultaneous electromyography and motion picture photography, our research group has been studying the relationship between the intrinsic and extrinsic musculature of the normal, moving hand. The first aim of the study is to differentiate between those motions possible to a certain muscle group and those actually performed by it. We have delineated specific motions which isolate the particular functions of the intrinsic and extrinsic muscles. Forty-four normal subjects have been tested in 70 experiments. The last nine of these have satisfied our own criteria of scientific acceptability. These experiments included the third dorsal interosseus and the extensor digitorum to the long finger. The dorsal interosseus is active during metacarpophalangeal flexion when the interphalangeal joints are extending or being held stiff by the subject; it is not active during closing of the full hand. It is usually active when the interphalangeal joints are being extended, regardless of the position or direction of movement of the metacarpophalangeal joint. The extrinsic extensor is active when the metacarpophalangeal joint is extending or being held extended. It is not active during stiff-fingered flexion of the metacarpophalangeal joint, nor during the combined motion of metacarpophalangeal flexion and interphalangeal extension.

The kinesiology world is becoming increasingly aware of the feedback mechanisms that form the basis of central nervous system control of coordinated motor action. During the past 16 years the actual function of living, moving muscle has been brought under fine scrutiny. In 1944 in his classic study of the shoulder, Verne Inman¹ demonstrated a function of the *teres major* which is entirely different from that predictable on the basis of its origin and insertion alone. He went on to produce in 1947 a study² of the muscular control of normal gait. With the assistance of an engineering team he demonstrated that the discovered functions are mechanically logical, although they differ heavily from the previously supposed functions of lower extremity muscles. He showed that the quadriceps is not the muscle responsible for knee stability in mid-stance, that the *gluteus maximus* is not a propelling but a retarding muscle, and that the dorsiflexors are not primarily toe lifters, but retarders of the body weight at heel-strike. The kinesiology breakthrough of which

these studies are representative was made possible by the addition of the electromyograph to our investigative armamentarium. With the arrival of electromyography it became possible to measure the actual function of muscles during active motion rather than to presume function on the basis of origin and insertion.

Two years ago the Highland View Hospital-Western Reserve University group began an electromyographic kinesiology study of the normal moving hand. The study's first objective is an examination of the normal function of the extensor mechanism. This mechanism includes the insertions of the extensor digitorum, the dorsal and palmar interossei, and the lumbricales. The extensor digitorum is anatomically capable of metacarpophalangeal (MP) extension and interphalangeal (IP) extension. The remaining muscles, the intrinsic, in general are capable of MP flexion and IP extension. The dorsal interossei are exceptional among the intrinsic muscles; they are capable only of IP extension, since their tendons pass too close to the center of rotation of the MP joint to develop a significant rotary moment. It is our purpose to discover which of these muscles is contributing to the control of the extensor mechanism during all motions possible to the hand.

Method

Our experimental method was reported in 1959 to the American Congress of

From the Highland View Hospital.

This study was partially supported by a grant from The National Foundation to Western Reserve University School of Medicine-Highland View Hospital.

Read at the 3rd International Congress of Physical Medicine, Session on Electromyography, Washington, D. C., August 22, 1960.

Physical Medicine and Rehabilitation.³ The method uses simultaneous ink-written, multi-channel electromyography and motion picture photography. Our electrodes are single strands of 28 micron nickel alloy wire. Seventy experiments have been performed on 44 subjects. The last nine of these experiments have been fully instrumented and serve as the basis for this initial analysis. The tested muscles were the extensor digitorum of the long finger and the dorsal interosseus on the ulnar side of that finger. The long finger was chosen as the first to investigate because it offers intrinsic control by two dorsal interossei, both easily accessible. The third dorsal interosseus was chosen over the second because of its slight preponderance of extensor mechanism attachment over bony attachment (60 per cent mechanism, according to Eyler and Markee.)⁴ Because of its extensor mechanism insertion, the third dorsal interosseus is representative of intrinsic control of that mechanism through the lateral bands. The extensor digitorum is representative of extrinsic control, which may be exercised either through the same lateral bands or through the central slip to the middle phalanx. This report includes the results of studying these two muscles, and suggests a hypothesis of their interaction. Further study will be necessary to show whether this hypothesis can be extended to extrinsic-intrinsic balance in the remainder of the hand.

The electromyograms used here as illustrations are specimens from each of five exercise situations selected to evoke extrinsic-intrinsic interaction. Motion curves are recorded for wrist, metacarpophalangeal, proximal interphalangeal and distal interphalangeal joints.

Before the performance of each specific exercise the subject is taught to flex and extend the fingers rhythmically, moving at his own rate, and without hesitation. In practice an involuntary pause occurs before each change in direction. Four phases of each exercise are identifiable: closing, hold-closed, opening, and hold-open.

Electromyograms in Test Motions

The extensor digitorum and ulnar interosseus of the long finger are reported first separately, then together, as the hand moves through each of the five test exercises.

Full Opening and Closing. The subject alternately opens the hand fully and closes it until the finger tips lightly touch the palm (fig. 1).

Extensor digitorum: during opening and hold-open, activity was always present at a high level. During the first half of closing, a small amount of activity was consistently present. During the second half of closing, all subjects were consistently inactive or minimally active. During hold-closed, some subjects showed small amounts of activity.

Third dorsal interosseus: during opening and hold-open, at least moderate activity was present. This activity often took the form of a crescendo in opening with marked activity during hold-open. As the hand began to close, the activity fell off to minimal levels. During hold-closed, minimal to moderate activity appeared.

On the basis of these records it is likely that the extrinsic and intrinsic combine to produce extension of the finger during opening of the full hand.

Opening and Closing with MP's Held Flexed. The subject holds full flexion at the metacarpophalangeal joints as he curls and straightens his fingers (fig. 2).

Extensor digitorum: in hold-closed the major and consistent area of activity was exhibited. Opening and hold-open were also accompanied by activity, but the level of voltage was lower than in hold-closed. In closing, there was always relative inactivity.

Third dorsal interosseus: in all subjects, except one, each full cycle of opening and closing demonstrated two major areas of activity. One occurred

during the continuous motion of opening and hold-open, and the second during hold-closed. With one exception, closing was accompanied by minimal or zero activity.

According to these records, with the metacarpophalangeal joints held flexed, opening calls forth combined activity of the intrinsic and extrinsic. On the basis of observed voltages, the intrinsic is performing more work than the extrinsic. During interphalangeal extension some cycles were observed in which the extrinsic was not functioning at all, suggesting that the intrinsic is the major muscle responsible for that motion.

During hold-closed the major activity of the extrinsic is not explained. It should

be noted that the same position of the fingers is reached after closure of the full hand, but that the extrinsic is not active at that time.

Opening and Closing with MP's Held Extended. The subject holds full extension at the metacarpophalangeal joints as he curls and straightens his fingers (fig. 3).

Extensor digitorum: throughout the entire cycle of movement some degree of activity was present. During each cycle, periods of increased activity occurred twice in all subjects. During hold-closed the maximum voltages were consistently generated. During the late phases of opening and during hold-open, the second peak appeared.

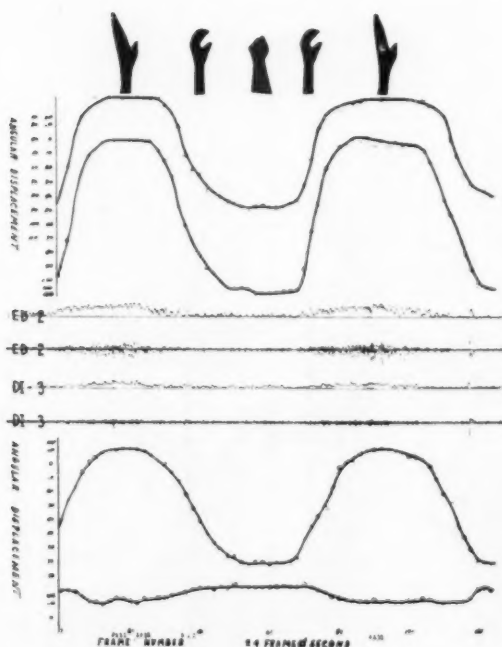


Fig. 1 — Opening and closing the whole hand. Electromyograms and joint displacement curves. Order is, from top down, distal interphalangeal joint; proximal interphalangeal joint; electromyograms of the extensor digitorum to the long finger (ED2) and the third dorsal interosseus (DI 3); metacarpophalangeal joint, and wrist joint.

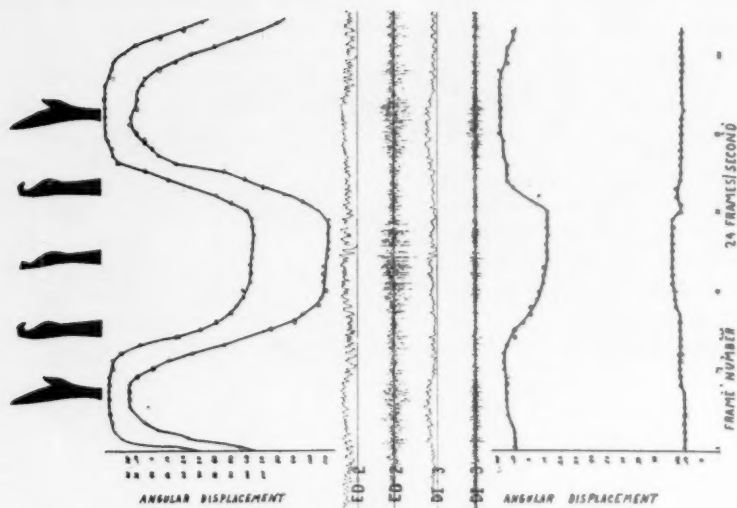


Fig. 2 — Opening and closing with metacarpophalangeal joint held flexed.

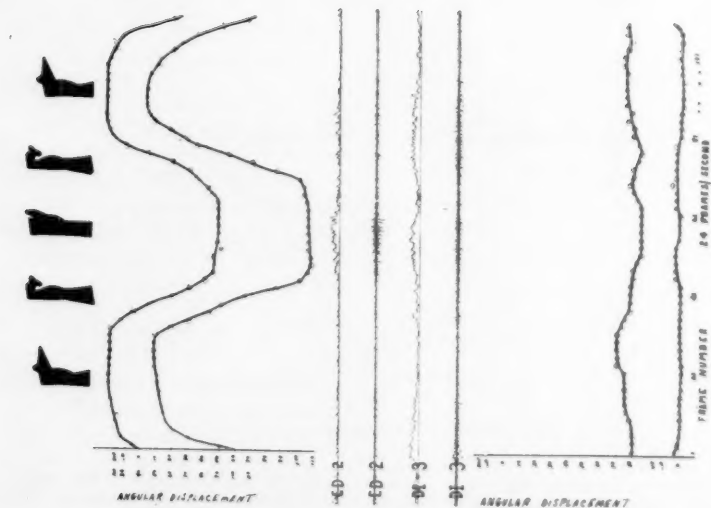


Fig. 3 — Opening and closing with metacarpophalangeal joint held extended.

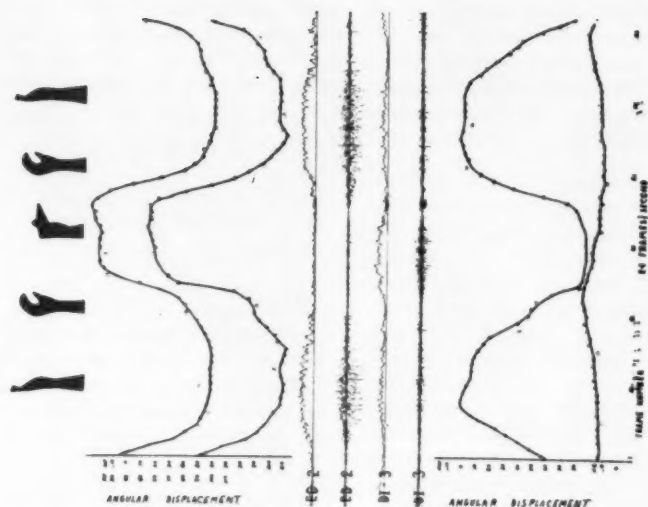


Fig. 5 — Curling the fingers while extending the metacarpophalangeal (MP) joint. Straightening the fingers while flexing the MP joint.

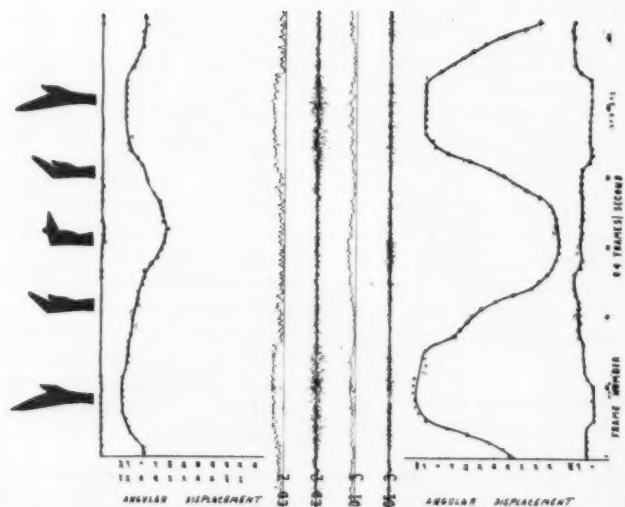


Fig. 4 — Straight fingered extension and flexion at the metacarpophalangeal joint.

Third dorsal interosseus: activity here was usually also biphasic in each cycle. During opening and hold-open the more consistent activity occurred. During hold-closed the second activity appeared, usually less than the opening voltages. The entire closing motion and the beginning of opening were accompanied by relative inactivity.

The findings suggest synergistic activity of the extrinsic and intrinsic in extending the interphalangeal joints while the metacarpophalangeal joints are held extended. The extrinsic is most active during hold-closed when it must resist the action of the long flexors, and again during opening and hold-open when it is assisting extension of the interphalangeal joints. Continuous background activity of the extrinsic is required to keep the metacarpophalangeal joints extended for this special motion. The voltages generated during hold-closed in the third dorsal interosseus are not explained.

Stiff-Fingered Flexion and Extension at MP Joints. The subject keeps his fingers straight as he flexes and extends at the metacarpophalangeal joints (fig. 4).

Extensor digitorum: opening and hold-open always produced the greatest activity. The onset of flexion in most subjects was followed by a sudden drop of activity to a minimal, sustained level. Some subjects showed continuous moderate activity.

Third dorsal interosseus: closing invariably produced the major period of activity which persisted through hold-closed. Throughout the cycle in most subjects, minimal activity was seen. During opening minimal to moderate activity occurred.

A reciprocal relationship is noted between extrinsic and intrinsic function, with extrinsics active during extension of the metacarpophalangeal joint and intrinsics during flexion. Since the fingers are held stiff throughout both motions, the extrinsic and intrinsic must alternate responsibility for this stiffness.

Curling the Fingers During MP Extension; Straightening the Fingers During MP Flexion. The subject flexes the interphalangeal (IP) joints while extending the metacarpophalangeal (MP) joint, then extends the IP joints while flexing the MP joint (fig. 5).

Extensor digitorum: during combined MP extension and IP flexion the major activity of the extensor digitorum occurred consistently. During the phase MP hold-flexed, IP hold-extended there was inconsistent, minimal to moderate activity in some subjects.

Third dorsal interosseus: during MP flexion, IP extension and its terminal holding phase major activity occurred consistently. During MP hold-extended, IP hold-flexed minimal activity was seen.

Again a reciprocal relationship is seen between the intrinsic and extrinsic muscles. The extrinsic acts during MP extension; the intrinsic acts during MP flexion.

Interpretation

In the preceding summaries of findings, the electromyographic activity of the extensor digitorum and the interosseus has been related to specific test motions. It is possible to analyze these data further to determine electromyographic patterns common to several test motions for each of these muscles.

Extrinsic. The extensor digitorum has one area of common action. When the metacarpophalangeal (MP) joint is extending or held extended the extensor digitorum is always active. Two areas of specific action are noted. When the hand is held closed after closure with the MP's held flexed, consistent extrinsic activity appears. When closure is attempted with the MP's held extended, extrinsic activity is again present.

Intrinsic. The interosseus also shows one area of unfailing activity. When the interphalangeal joints are extending or held extended the interosseus is always active.

Extrinsic-Intrinsic Predominance. The degree of extrinsic or intrinsic predominance is consistently determined by the motion being performed. During interphalangeal extension or stiffness, there is intrinsic predominance if the metacarpophalangeal joint is flexing; when the MP joint is extending, this becomes extrinsic predominance. Full opening and closing of the hand show primarily extrinsic predominance, with major assistance from the intrinsic only in terminal extension. As in any biologic study, variations appear within the majority behavior, and exceptional instances of opposite behavior occur. Some subjects can be identified as basically intrinsic or extrinsic predominant.

Conclusions

This study suggests the elaborate discretionary powers available to the muscles controlling the hand. It reaffirms the postulate that a specific muscle performs a specific job because it is best suited for that job at the moment, not only because it lies in an anatomic area where it might be active. Servomechanisms are constantly in force to determine the muscle groups best able to perform a complex motion without hindering any portion of the motion.

For the present, the following is our working hypothesis. The extrinsics serve, with little assistance, to provide the gross motion of opening and closing all of the

joints of the hand simultaneously. The intrinsics perform their major function when it is necessary to depart from the pattern of total finger extension or flexion. Function of the intrinsics depends primarily on the total motion required of the finger rather than upon the position of the metacarpophalangeal or any other particular joint. The intrinsics are the primary extensors of the interphalangeal joints if the metacarpophalangeal joint is flexing, but the extrinsic is the major extensor of the same joints if the metacarpophalangeal joint is extending. At any instant, the balance between extrinsic and intrinsic muscles depends not upon position of the several joints, but upon their direction of movement.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



Electromyographic Method for Objective Measurement of Muscle Relaxant Drugs

Charles R. Peterson, M.D.
and

Charles S. Wise, M.D.
Washington, D.C.

● An objective method is described for measuring the effects of a muscle relaxant drug, carisoprodol (SOMA), in man under acute controlled conditions. Electromyographic measurements of the patellar reflex in 23 patients with upper motor neuron disease were made during a control period and for approximately two hours following administration of the drug or placebo. Statistical evaluation of the depression of the quadriceps action potential in those patients receiving the drug revealed a significant difference from the controls (p equals 0.05 or less). The method described appears to be applicable to screening and comparative evaluation of the neurospasmolytic agents.

The effects of muscle relaxant drugs in the human are difficult to evaluate because the results reported usually are subjective. This study is an attempt to minimize subjective errors by measuring a controlled patellar reflex in patients with upper motor neuron spasticity. Electromyographic techniques were employed in 30 acute experiments in 23 subjects. Carisoprodol (SOMA) and placebo medication were used.

Method

Thirty experiments were performed, using 23 patients. Seven patients were tested twice, receiving the drug or placebo during one test period, and some days later receiving the other. Twenty of the patients had multiple sclerosis with spastic lower extremities, and three had spastic hemiplegia secondary to cerebral vascular accidents. Placebo and drug subjects were picked at random. Usually the experimenter did not know whether or not the capsule contained active material or placebo. In no instance did the patient know whether the drug or placebo was being used.

The drug used in all cases was carisoprodol, administered in brown gelatin capsules. Each capsule contained 400 milligrams of the drug. The dosage used was 800 or 1200 mg. The placebos were identical capsules filled with sugar which had the same gross appearance as the active drug.

Each patient was graded clinically for spasticity, a grade of one being minimal to four marked. The drug

group averaged 2.4, while the patients receiving the placebos averaged 2.5. Six of the drug group received 800 mg. of the drug, while 13 received 1200 mg. (table 1).

Table 1: Composition of Patients Tested
Received Drug (19) Received Placebo (11)

Age 20-29.....	1	0
30-39.....	7	6
40-49.....	10	4
50-65.....	1	1
Diagnosis:		
M. S.....	17	10
C. V. A.....	2	1
Clinical Data:		
Spasticity.....	Present in all patients tested (1+ to 4+)	
Babinski		
Pos.....	14	8
Equiv.....	2	2
Neg.....	3	1
Dosage (W-712)		
800 mg.....	6	0
1200 mg.....	13	0

The patient to be tested was placed in a specially constructed knee brace with the knee fixed in about 30 degrees of flexion. The thigh, calf, and knee were strapped firmly in position preventing any motion of the knee (fig. 1). Surface electrodes were securely taped in place over the belly of the quadriceps and connected to the upper channel of a TECA two-channel electromyograph. A ground electrode was placed proximal to the recording electrodes. The patellar reflex hammer was a standard hard rubber type, with adjustable weights placed near the striking head. The hammer was connected to the brace by means of a frame which was adjustable in the vertical and horizontal planes (fig. 2). The hammer itself had an adjustable stop to control the arc through which it fell to strike the patellar tendon.

This study was supported by a training grant provided by the Office of Vocational Rehabilitation, Department of Health, Education and Welfare.

Fellow in Physical Medicine and Rehabilitation, The George Washington University School of Medicine.

Professor of Physical Medicine and Rehabilitation, The George Washington University School of Medicine.



Fig. 1 — Experimental apparatus showing knee brace, patellar hammer and surface electrodes connected to the electromyograph.

The angle usually was about 90 degrees and fixed for the entire series of tests on each patient.

The quadriceps action potentials thus produced by the controlled myotatic reflex were recorded on tape and observed on the oscilloscope at a sweep speed of 1000 milliseconds per division. These potentials were photographed with a polaroid camera and measured in microvolts.

In each case prior to testing the patient rested for 30 minutes with the knee brace in place. Three control readings were then taken at 15 minute intervals. Following this the drug or placebo was administered and recordings made to 30, 60, 90 and 120 minutes. Four to 18 reflex jerks were elicited at each of these time intervals, the average being nine. The control studies were labeled C-1, C-2 and C-3, and the period after the administration of the drug or placebo 30 minutes, 60 minutes, 90 minutes and 120 minutes.

The three control readings in microvolts were averaged and the result designated C-average. Using this as the mean, percentage change was calculated for each reading. In this way, each patient served as his own control.

Results

Two typical results of experiments on a single subject are shown in figure

3. In this case the patient received the drug at one testing period, and the placebo on another test day. The initial control recordings on this patient on different days varied by 150 microvolts. From pilot studies it was found that we were unable to reproduce the exact microvoltage figures in the same subject on different days. This probably is due to an inability to reproduce exact electrode and knee placement, and hammer strike. For this reason the study was designed as an acute experiment and each patient served as his own control.



Fig. 2 — Knee brace with adjustable frame and patellar hammer.

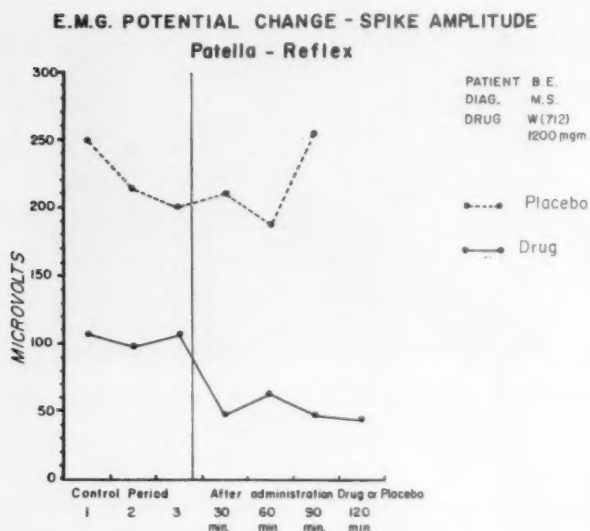


Fig. 3 — Graph showing typical results on one patient who received drug and placebo on different testing days.

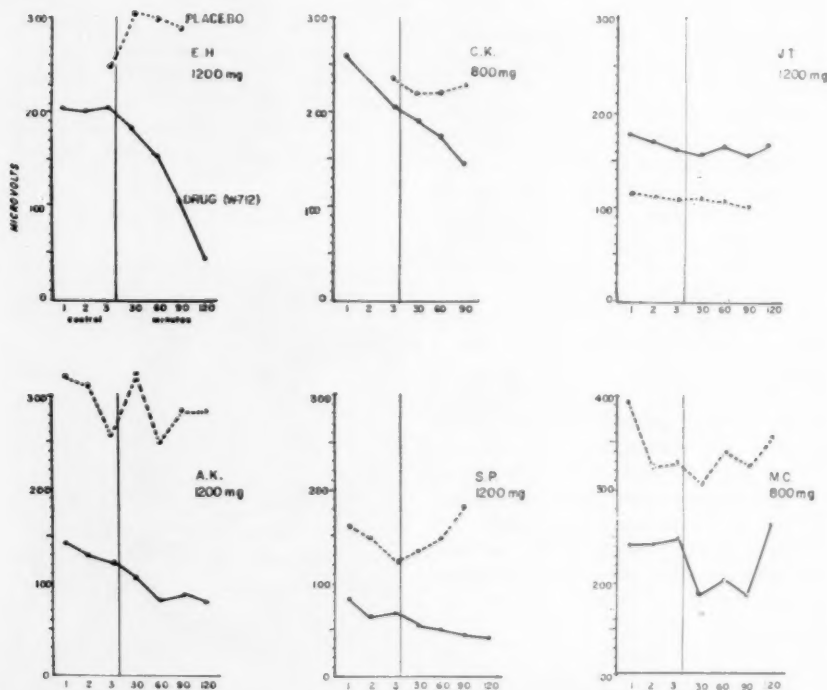


Fig. 4 — Graph showing experimental results on six additional patients receiving drug and placebo.

Figure 4 illustrates the other six subjects who received both drug and placebo. One rather constant finding in all the tests was an initial drop during the control period, probably due to relaxation of the patient as he became used to the testing situation. The tests were randomized with regard to the drug and placebo so there could be no "learned" relaxation effect in the measurements.

Since the microvoltage readings varied so greatly from patient to patient it was decided to use the average microvoltage recording of each patient's three controls as a baseline. Percentage deviation from this mean was calculated for each response before and after the administration of the drug or placebo.

A scattergraph (fig. 5) of the placebo group illustrates the responses of this group. Figure 6 represents the drug group in the same manner. It should be noted that following the drug only

four of 69 readings show a positive deviation or increase in spike height, while in the placebo group 13 of the 35 are positive.

A graph showing the average percentage deviations of the seven patients who received both drug and placebo is shown in figure 7. The curves essentially are the same as the total sample.

The data obtained was subjected to statistical analysis; it was found the standard deviations of the control readings were ± 12.65 per cent for the drug group, ± 8.08 per cent for the placebo group and ± 10.5 per cent for the combined groups. The 95 per cent confidence limits (± 2 standard errors) were ± 3.50 per cent for the drug group, ± 3.06 per cent for the placebo group and ± 2.36 per cent for both combined. This error range gives a reasonable amount of confidence in the reproducibility of readings based upon a

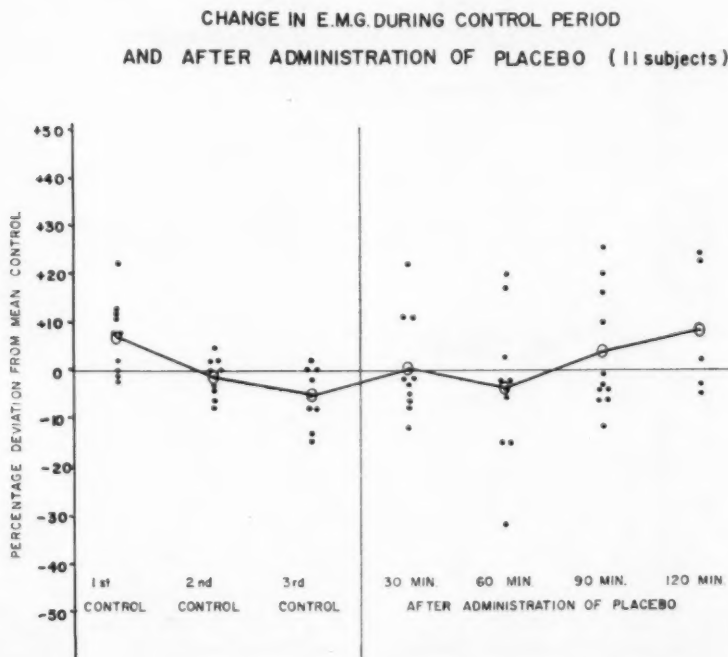


Fig. 5 — Scattergraph of 11 subjects who received placebo medication. The results are calculated as percentage deviations from the mean of each subject's three controls.

similar number of determinations. An analysis of the results in the patients receiving placebos showed no significant change when compared to their own controls (p value equal or greater than 0.3). Using the same analysis on patients receiving the drug the percentage changes were significant at all time intervals (p equals 0.05 or less). At the 60 and 90 minute recordings, a p value of less than 0.001 was found. In a crossover comparison of the patients receiving both drug and placebo, the paired differences in percentage change from control averages are significant (p equals 0.05 or less) at the 30, 60, 90 minute readings. There was insufficient data to evaluate the 120 minute recordings.

Discussion

In the past two decades new observations in neuromuscular physiology and the adaptation of research tools

has made it clinically feasible to study the monosynaptic reflex in man. Renshaw¹ in 1940 identified a monosynaptic connection between the largest afferent fibers and the spinal motor neurons. The clinical application of the electromyograph led the way to objective measurements of the response of the lower motor neuron pool in the human. The monosynaptic reflex has been studied both by electrical stimulation of the afferent fibers as well as by mechanical stimulation of the stretch receptors in the muscle². The patellar reflex is initiated through the Matthews³ type A2 receptors of the neuromuscular spindles and propagated through Lloyd's⁴ Group I fibers to synapse with the motor neuron. The use of this reflex in animal experimentation is well known. Del Castillo and Nelson⁵ employed the patellar reflex response in cats to determine the site of action of carisoprodol. The drug was adminis-

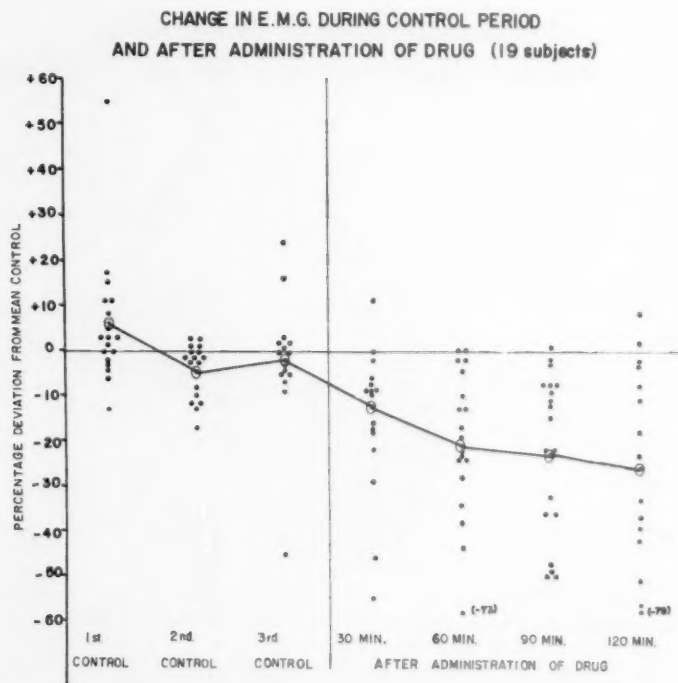


Fig. 6 — Scattergraph of drug patients using same method as figure 5.

tered intravenously in decerebrate or nembutalized animals. This carefully planned experiment demonstrated the effectiveness of the drug in abolishing decerebrate rigidity. The effect on the spinal reflex, however, was less marked. When the patellar reflex was potentiated by the administration of parenteral eserine, however, carisoprodol effectively removed this potentiation. Similar effects of the drug were noted on electrically facilitated patellar reflexes mediated through the reticulospinal tract.

Many clinical workers have devised methods to evaluate the muscle relaxing series of drugs in humans. Vazuka⁶, using an inkwriter electromyograph, tested ankle clonus and reflex activity of the gastrocnemius under graded tension; Boczko and Mumenthaler⁷ employed a modified pendulousness test of the thigh muscles; and Levine⁸ et al used a polygraph in testing the electrical response of the quadriceps to electrical stimulation, body tilt, and

the Babinski response. These studies tested subjects before and after several days or weeks of medication. In experiments such as these placing the test subject and apparatus physically in an identical test situation on different days is critical for dependable results. By the use of acute experiments as described in this paper, and controlling the test conditions for the duration of each experiment, it was felt that more accurate results could be obtained. Splinting of the subject's extremity and a reproducible mechanical stimulus were found to be necessary. These conditions could be met only in an acute experiment.

Drowsiness was the only side effect noted from the drug. This factor of central depression should be studied further. Drowsiness occurred in only a minority of the drug patients, however, and equally as many of the placebo patients fell asleep during the test. Further experiments are planned using central nervous system depressants in

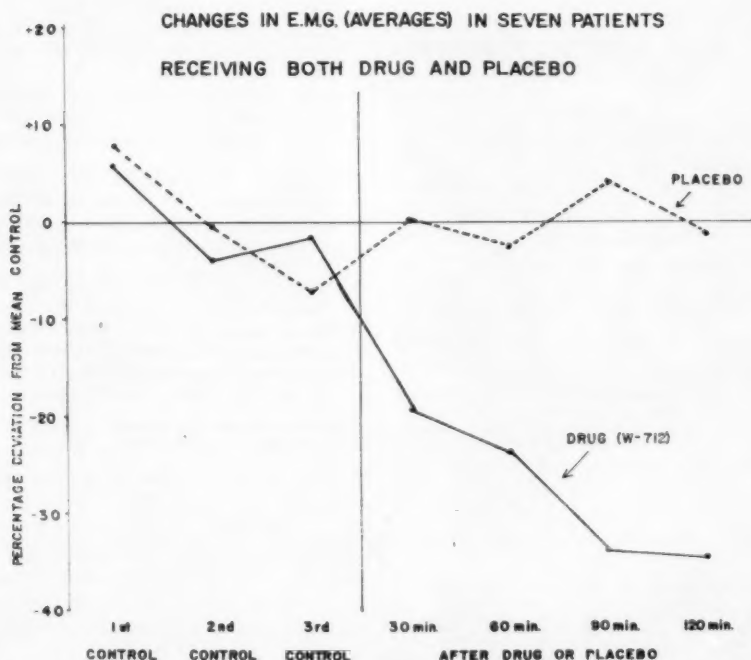


Fig. 7—Average percentage deviation of seven patients who received both drug and placebo.

comparison with muscle relaxing drugs.

The results of this experiment are consistent with the absorption studies of Berger et al⁹ who report peak blood concentrations of carisoprodol one to two hours after ingestion. In our experiment patient tolerance of immobilization usually permitted only two hours of observation after administration of the drug. Since the greatest depression of the reflex activity occurs in the last period of observation, we cannot determine when the maximum effectiveness of the drug occurs.

A dose larger than normally employed clinically was decided upon because of the acute nature of the experiment. In clinical trials the additive effects of multiple doses probably produce equally high blood levels.

Although the studies herein reported show a significant effect of carisoprodol on the hyperactive patellar reflex in organic neurologic disease, one cannot draw any conclusions as to its clinical effectiveness. Such conclusions must be based on careful clinical trials. The objectivity of the method described, however, lends itself to screening and comparative evaluation of neurospasmolytic agents in the human.

Summary

An objective method is described for measuring the effects of a muscle relaxant drug, carisoprodol (SOMA), in man under acute controlled conditions. Electromyographic measurements of the patellar reflex in 23 patients with upper motor neuron disease were made during a control period and for approximately two hours following administration of the drug or placebo. Statistical evaluation of the depression

of the quadriceps action potential in those patients receiving the drug revealed a significant difference from the controls (p equals 0.05 or less). The method described appears to be applicable to screening and comparative evaluation of the neurospasmolytic agents.

Acknowledgment: The authors wish to express their appreciation to Mr. Peter Greenburg for his technical assistance. The carisoprodol (SOMA) was supplied by Wallace Laboratories.

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Courage is grace under pressure.

—ERNEST HEMINGWAY

A Study of Peripheral Nerve Involvement in Fifty-Four Patients with Multiple Sclerosis

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and
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● Involvement of peripheral nerves is not a prominent feature of multiple sclerosis, at least in the chronic stage and does not represent a problem in rehabilitation. Out of 54 examined three were found to have one or more peripheral nerves involved, in two of these the lesion was clearly due to compression. A brief resume with the most prominent findings of these three cases is given. This observation points to the need for careful consideration and attention to be devoted to the positioning of the patient in bed, wheelchair or Stryker frame, to avoid a further damage being added to an already fragile organism.

Proper rehabilitation evaluation of patients with multiple sclerosis requires a precise description of the underlying neurologic deficits. The major focus of evaluation in multiple sclerosis involves testing function of the nervous system proximal to the peripheral nerve. The role, if any, of peripheral nerve involvement in influencing musculoskeletal function in multiple sclerosis has not been adequately determined. Complaints have been voiced in some recent publications^{1,2} that scant attention is paid to the peripheral nerves in multiple sclerosis, that "the peripheral nerves have not been satisfactorily investigated in disseminated sclerosis"³ and that "the involvement of peripheral nerves may be more common than is generally accepted."⁴

Subjective and objective sensory disturbances of various kinds, paresthesias, dysesthesias, fugitive pains and other abnormal sensations are quite a common occurrence in multiple sclerosis.⁵⁻⁷ There is no proof, however, of their definite relation to the involvement of a specific nerve or root.

Paralysis of various cranial nerves is reported to be a common early sign.⁸ Cases of isolated peripheral facial, ocular or trigeminal nerve paralysis, later developed into the full blown picture of multiple sclerosis.⁹⁻¹² References also are found of cases with involvement of more than one nerve and even of polyneuritis, combined with multiple sclerosis, so that one speaks of a polyneuritic form of multiple sclerosis.

One author² recently has emphasized

the point that participation of peripheral nerves in multiple sclerosis does occur and has even advanced the hypothesis that "neuritis and multiple sclerosis are not strangers" and between the two entities there can be closer etiologic, anatomopathologic and clinical relations than had hitherto been suspected. Unfortunately, in most of the reports cited above, neither objective nor pathologic evidence is given of the lesion involving the various nerves incriminated.

Pathologic studies of peripheral nerve lesions in multiple sclerosis are scanty and the subject is not even mentioned in some extensive reviews¹³ or textbooks. In a recent study¹ of 20 patients with multiple sclerosis in which peripheral nerves were available for examination, 12 had diffuse demyelination but no plaque-like lesion was found. The distal segments of the nerve trunks were most severely degenerated. The type of demyelination found by the authors was not comparable to the patches or plaques of multiple sclerosis seen in the central nervous system and was interpreted as due to malnutrition with consequent avitaminosis.

Other reports on the pathologic anatomy of peripheral nerves in multiple sclerosis may be found especially in the German literature.¹⁴⁻¹⁷ These studies do demonstrate pathologic changes involving the cranial, spinal and peripheral nerves. A demyelination process, quite similar to that known in the central nervous system, in the form of plaques, was described by some authors,^{15, 16} but in most of the cases the changes were those of a diffuse

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and interstitial neuritis. In Merritt's textbook of Neurology the author notes that "roots of spinal and cranial nerves may be affected by the plaques."

Because of these conflicting views as to the prevalence and severity of peripheral nerve involvement in multiple sclerosis the present study was undertaken.

Procedure

Patients were selected from the long term hospital population of Bird S. Coler Hospital, a 2,000 bed municipal chronic disease institution. After careful screening of history and physical examination 54 patients were considered definitely as multiple sclerotic, 34 females and 20 males. The average age of this group was 47, the youngest patient being 27 and the oldest 75. The duration of the disease ranged from two to 35 years. Forty-five patients were wheelchair bound and seven were bedridden because of marked flexion contracture of lower extremities or extreme ataxia.

Complete neurologic examination was performed with special emphasis given to the cranial nerves and sensory and motor distribution of the nerves of the upper and lower extremities. Each patient was examined by two observers and by a third observer if there was any doubt concerning the findings.

Sensory Examination

Reversing the usual routine of examination, the sensory system was first explored in each patient in order to minimize the effect of fatigue. The sympathetic component of the peripheral nerve also was tested. The tests used were: (1) thermoregulatory sweating, using quinazarin as an indicator and (2) measurement of skin resistance. The rationale of these two tests is too well known to require a description at this time and their usefulness as objective methods of examination in peripheral nerve lesion has been recently emphasized.¹⁸⁻²⁰ Skin resistance was measured in every case. The sweat test was performed only in those cases with either a definite or possible peripheral nerve lesion.

Motor Examination

Special care was taken to observe any sign of atrophy, flabby musculature, hypotonia, decreased or absent reflexes. Objective evaluation was performed using the technic of electromyography, chronaxy and nerve stimulation in all cases suspected of having lower motor neuron lesion. Such testing was not considered indicated in patients with clearly evident hyperreflexia, increased tonus and normal muscle bulk.

Results

Only three patients (1.6 per cent) had definite signs of peripheral nerve involvement. The nerves involved were the right radial in one case, the left motor peroneal in another and both peronei (sensory on the right, and partial motor on the left) in the last case. A brief resume with the most prominent findings of these three cases is given:

1. A 52-year-old white male, apparently was well until about 14 years ago when he developed diplopia, difficulty in walking and numbness of the left hand. Diplopia disappeared but the other complaint remained stationary until 1950. From this time on he got progressively worse and in 1954 he was hospitalized in various institutions. He became wheelchair bound around the same time and has remained so since. The patient is an alert, cooperative, oriented white male of average intelligence, who sits in a wheelchair all day long. Because of poor balance his usual sitting posture results in his right arm pressing against the wheelchair arm rest. The general physical examination, except for the presence of a kyphosis was not remarkable. Positive findings related to the cranial nerves included: 1. bilateral temporal optic atrophy; 2. horizontal and vertical nystagmus; 3. absent gag reflex. Cerebellar speech was present. Functional power was fair in upper extremities, except for the right wrist and finger extensor muscles, which were completely paralyzed, giving the hand the classical appearance of radial nerve palsy. The patient informed us that he had been able to move the right hand normally

until two weeks before our examination. No motor power was present in the lower extremities. Both lower extremities were markedly spastic with bilateral hyperreflexia, clonus and Babinski. Deep tendon reflexes on the left upper extremity and the right biceps reflex were normal. The triceps and the radial tendon reflex were absent on the right. Touch and pain were normal throughout. Position and vibration sensations were absent in both lower and left upper extremities, normal in the right upper. Two point discrimination was lost in the lowers and left upper extremities, normal in the right upper limb. Sterognosis was absent on the right. Chronaxy and electromyography were carried out on several muscles of the right arm. Abnormal findings included slow, vermicular contraction on galvanic stimulation of the extensor carpi ulnaris and radialis, extensor digitorum communis, extensor pollicis longus with chronaxy values ranging from 0.5 to 0.7 msec. Numerous fibrillation potentials were present at rest in all the extensor muscle groups of the forearm, with no action potentials on attempted voluntary contraction. The triceps brachii, the flexor muscle group, and the intrinsic muscles of the right hand gave normal response. The diagnosis was made of right radial nerve palsy, in its distal part, of recent onset, and probably due to compression.

2. A 45-year-old white female had the first symptom of her condition in 1951 with sudden onset of blindness in her right eye. There was a gradual improvement but she never regained full vision. She was well until 1953 when vision in the left eye also became impaired. At the same time difficulty in ambulation, stiffness of both lower extremities, urinary frequency and urgency were noted. She was, however, able to get around and attend her duties as housewife until 1957 when, following a hysterectomy under general anesthesia, her disability increased considerably. She was no longer able to walk and became completely incontinent. Because of development of decubiti around the sacral area and both trochanteric regions the patient entered the hospital in 1958.

She was kept on a Stryker frame for about six months and now is able to sit in a wheelchair. The general physical examination is not remarkable. There is bilateral optic atrophy and bilateral horizontal nystagmus with no other cranial nerve involvement. Power and tonus are good in both upper extremities. There is spastic paralysis of both lower extremities with hyperreflexia, clonus and Babinski on the right. The left knee jerk is hyperactive. There is left foot drop with absent ankle jerk and normal plantar toe response. Wasting of the anterior muscles of the left leg is evident. Deep tendon reflexes in the uppers are hyperactive with bilateral Hoffman. Sensory examination is not remarkable except for loss of position sense and two point discrimination in the lower extremities. Sweat test was inconclusive. Chronaxy studies of both legs gave values within normal limits on the right. On the left the following values were obtained: Peronei 15 msec. Gastrocnemius 0.2 msec., anterior tibial and extensor hallucis and longus could not be made to contract, even when attempting stimulation of the nerve in the popliteal fossa and around the head of the fibula. Electromyography of the anterior tibial, extensor hallucis longus and peronei revealed during insertion or probing with the needle electrode a burst of prolonged activity resembling fibrillation potentials, otherwise the muscles remained silent. No active potentials were present on voluntary or reflex evoked contraction of the leg. Electromyography of the left gastrocnemius and the muscles of the right leg did not show any abnormal insertion activity and showed burst of numerous action potentials when these muscles were reflexly activated. The clinical and electrodiagnostic picture was compatible with left common peroneal nerve paralysis.

3. A thirty-year-old white female, housewife, had the first hint of her disease in 1952 with a blurring of vision that lasted a few weeks and then disappeared. During the following years she had progressive onset of muscular weakness, difficulty in walking, incontinence, and speech

abnormality, with a few partial remissions. She became wheelchair-ridden in 1956 and started to develop decubitus ulcers in numerous areas of her back, trochanteric region, knee and heels. The patient entered Bird S. Coler Hospital in January, 1958. At the time of our examination the patient was bedbound because of extreme flexion and adduction contractures of both lower extremities. Incontinence was present. She appeared markedly emaciated with diffuse muscular wasting, but alert, cooperative and oriented. The speech was cerebellar. Numerous scars of old healed decubiti were present over the regions mentioned. Two small ulcerations were still present on both heels. Bilateral optic atrophy, horizontal nystagmus, limitation of extraocular movement on lateral gaze, central type paresis of the left VII nerve were the pathologic findings on examination of the cranial nerves. Tone and power were good in the left upper extremity. The right arm was spastic with hyperactive deep tendon reflexes and Hoffman's sign present. Reflexes were normal on the left. Both lower extremities, as already mentioned, were in marked flexion contracture at the hip and knee with increased contraction in flexion at any attempt of manipulation. Deep tendon reflexes could not be elicited. Babinski was present bilaterally.

Touch and pain was present throughout except over the distribution of both superficial peroneal nerves. Position sense was normal while vibration was absent in both lower extremities. Stereognosis was lost. Two areas of high skin resistance corresponding to the distribution of the superficial peroneal nerves was clearly delineated. Because of the patient's condition and the difficulties in positioning her, the sweat test was not carried out.

Chronaxy read as follows: right anterior tibial 0.4 msec.; right extensor hallucis longus 0.5; right peronei 0.4; right gastrocnemius 0.15; left anterior tibial 30 msec.; extensor hallucis longus 25; left peronei 0.30; and left gastrocnemius .30.

The left gastrocnemius and the muscles of the right leg did not show any abnormal electromyographic find-

ings. Exaggerated and lively insertion activity was evident in the anterior muscle groups of the left leg, with presence of fibrillation like potentials appearing and persisting for some time on movement of the needle electrode. The sensory and electrodiagnostic findings were persistent and unchanged on several examinations.

The diagnosis of partial lesion of both peroneal nerves was made. The etiology was obscure, and the role of multiple sclerosis is certainly not definite. The poor general condition of the patient, the numerous decubiti suffered in the past and which are still present, the extreme flexion contractures of both lower extremities could also favor in this case a toxic, a nutritional or a pressure factor, as the possible etiologic agent.

The clinical features noted in the remaining 51 patients were varied, complex and characteristic of those usually seen in multiple sclerosis. The findings of our clinical and electrodiagnostic investigation failed to uncover any other peripheral nerve involvement, and since they shed no light upon the problem of this presentation, they are not reported. Some of the findings of the sensory examination are summarized in tables 1 and 2. It can be rapidly seen (table 1) that the more elementary forms of sensation were found normal in all patients, except those in whom a transverse type of cord lesion existed and a segmental sensory level was present.

More complicated forms of combined sensation, like stereognostic sense, graphesthesia, two point discrimination, were however found to be completely lost or severely compromised in quite a large number of patients (table 2). The loss or blunting of these sensations did not follow any particular nerve or root distribution and must therefore be considered of central origin.

Discussion

The present study lends little support to the above noted observations of peripheral nerve involvement in multiple sclerosis. Since our populations represented a severely disabled group with mainly long standing diseases, it is

Table 1: Sensory Disturbances (Touch, Pain, Position and Vibration) in 54 Cases of Multiple Sclerosis

	Touch	Pain	Position Sense	Vibration Sense
Normal	48	48	23	27
Impaired in both lower extremities	6*	6*	15	18
Impaired in upper and lower extremities	0	0	14	8
Impaired in only one leg	0	0	2	1
Impaired in only one arm	0	0	0	0
Total No. of patients	54	54	54	54

0 — Impaired is used here to mean complete loss or great diminution.

*Patient No. 3 (see text), with bilateral peroneal palsy, also included here.

Table 2: Sensory Disturbances (Stereognosis, Graphesthesia and Two Point Discrimination) in Multiple Sclerosis

Sensation Tested	Number of Patients Tested	Normal	Compromised or Lost
Stereognosis	54	27	30
Graphesthesia	39	26	13
Two Point Discrimination	27	11	16

reasonable to assume that a more widespread neurologic involvement could be expected. In two of the three cases where peripheral involvement was determined, it was possible to relate this involvement to extrinsic pressure. In only one case could multiple sclerosis be considered the presumptive cause, but its true pathogenetic role is not clear.

The specific pathologic findings reported by the authors, who have examined the problem, would suggest that other complicating factors may play the major role in the development of peripheral nerve lesion and multiple sclerosis represent only an associated or predisposing condition.

Vitamin deficiency or other nutritional defects, for instance, may favor and actually cause peripheral neuritis, as suggested by the recent pathologic report of Hasson, Terry, and Zimmerman.¹ In this survey the problem of the nutritional factor as causative agent does not seem to be prominent. Our population lived in an hospital environment where nutritional requirements and dietary intake are more closely and accurately controlled. We cannot, however, under-

estimate the importance that dietary intake, quantitatively or qualitatively deficient, may assume in multiple sclerosis and in chronic debilitating conditions in general. Not infrequently, the patients cannot feed themselves adequately and nutritional deficiencies may easily occur and predispose to an array of pathologic manifestations, of which peripheral neuritis may be only one aspect.

In the early and acute stage of the disease, signs and symptoms of peripheral type of lesion may very well exist, but these eventually disappear, and are not more evident in the chronic stage, as our study seems to suggest.

Summary

Involvement of peripheral nerves is not a prominent feature of multiple sclerosis, at least in the chronic stage and does not represent a problem in rehabilitation. Out of 54 cases examined, three were found to have one or more peripheral nerves involved and in two of these, the lesion was clearly due to compression. This observation points to the need for careful consideration and attention to be devoted to the positioning

of the patient in bed, wheelchair or Stryker frame, to avoid a further damage being added to an already fragile and compromised organism.

Acknowledgment: The authors wish to express their appreciation to Dr. Haskell O. Ellis for his assistance.

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Patience is power; with time and patience the mulberry leaf becomes silk.

—CHINESE PROVERB

This paper was presented at a seminar sponsored by the
AMERICAN REHABILITATION FOUNDATION

The Management of the Patient with Cerebral Infarction

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● The prognosis for functional recovery from a cerebral vascular accident with motor paresis is contrary to widespread medical opinion, less dependent upon the extent of neurologic involvement than upon the type and severity of the disease process which is present in the brain tissue. The best prognosis for functional recovery will be found in the young individual with a post-traumatic hemiparesis and the worst prognosis in the elderly individual with extensive cerebral insufficiency present before the development of the acute cerebral arterial infarction. Several common complications of which the physician must be aware before he can properly manage the patient with cerebral vascular disease are discussed. Problems of and suggestions for the management of the patient during the convalescence and rehabilitation period are described and given. The principles of management of patients which are briefly spelled out involve the basic concepts of physiologic and anatomic bed positioning, early mobilization, extensive muscular retraining and the re-teaching of functional activities within the limitations of the present disability utilizing the residual capacities and augmented by adaptive devices and braces. The author believes the majority of patients with a cerebral infarction can be restored to some degree of community and family living and no patient should be denied the privilege of such a management program.

The prognosis for functional recovery from a cerebral vascular accident with motor paresis is, contrary to widespread medical opinion, less dependent upon the extent of neurologic involvement than upon the type and severity of the disease process which is present in the brain tissue. This viewpoint has been forced upon me by my own clinical experience. All other things being equal the best prognosis for functional recovery will be found in the young individual with a post-traumatic hemiparesis and the worst prognosis in the elderly individual with extensive cerebral arterial insufficiency present before the development of the acute cerebral infarction. Less than one-third of hemiparetic individuals will recover full functional use of the upper extremity following such a vascular accident. Of the remainder one-half will recover no function and the others will recover clumsy, incoordinate, gross movements

only. Approximately one-half of all patients who incur a cerebral vascular accident will remain with a permanent drop foot deformity with an equinovarus foot position and a secondary circumduction gait resulting from this. This will usually require the use of a short leg drop foot brace to correct. Muscular flaccidity in the first 24 to 72 hours is not necessarily significant but its persistence implies a more extensive cerebral lesion than does the development of spasticity in the extremities and flaccidity is hence considered an indication of a poor prognosis for functional recovery. Aphasia is more commonly associated with cerebral vascular accidents in the dominant hemisphere of the brain but the clinical experience of many investigators indicates that a lesion in the non-dominant hemisphere often carries with it a large number of other sensory and perceptual disturbances which make for poor functional prognosis.

There are several common complications of which the physician must be aware before he can properly manage the patient with cerebral vascular disease. Homonymous hemianopsia or quadrantic visual field defects are not uncommon but are very easy to overlook on physical examination particularly if an associated aphasia is present

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which prevents the patient from communicating his own symptoms to the examining physician. No successful method of therapy exists for the correction of such visual field defects but their presence tends to interfere with the learning process of the disabled individual and with his re-training in a rehabilitation program.

Apparent emotional lability when present in such patients is usually on the basis of organic brain damage and is manifested as episodes of laughing or crying not related to external stimuli and not necessarily expressive of the true emotional tone of the patient. Such emotional outbursts hinder the successful rehabilitation of the patient and may actually tend to negate any benefits obtained from a rehabilitation program. A less common but quite devastating secondary disability is the presence of a causalgic state. In some individuals with extensive brain damage and particularly if the thalamus is involved in the cerebral vascular disorder there tends to develop a causalgic painful upper extremity with the characteristics of a phantom limb. The pain may be so severe that narcotics are required for control and when present in such a severe degree completely prevents effective rehabilitation of the patient. Unfortunately in my experience the therapeutic measures available for the control of such a causalgic state are few and if the patient is not helped by adequate dosage of tranquilizing drugs this condition may be therapeutically defeating. Several patients in my own personal experience have demanded and at other institutions have been provided with amputation of the offending extremity and in no instance has the causalgic state been permanently relieved by such amputation and in at least two such individuals the amputation has succeeded in precipitating a psychotic breakdown. It is considered inadvisable to permit such a procedure to be carried out despite the demands of the patient or his family.

The shoulder-hand syndrome is a

common, painful and disabling concomitant of cerebral vascular disorders and requires early and assiduous attention. The frequent movement of both upper extremities is valuable as a means of avoiding the development of a shoulder-hand syndrome. If the shoulder-hand syndrome does occur the use of local heat to the shoulder, preferably infrared or microtherm (primarily because of ease of application), and the encouragement of range of motion exercises of the shoulder with assistance is valuable. In addition bed positioning is encouraged which will place the shoulder in greater abduction and will maintain the involved extremity in an elevated position so that edema of the hand and forearm may be avoided. Oral or parenteral steroid drugs may be symptomatically helpful in relieving shoulder pain if no contraindication exists, and stellate ganglion blocks have enjoyed more acceptance when used for this purpose than for treatment of the cerebral infarction itself. While the shoulder-hand syndrome is not life threatening it is functionally incapacitating and cannot be disregarded in the management of such patients.

Aphasia which is most commonly an accompaniment of a cerebral vascular lesion in the dominant hemisphere of the brain may be receptive, expressive, or of the motor apraxic type involving speech muscles. In some instances it may be of a mixed variety including any or all of the components mentioned. The presence of extensive aphasia tends to produce a severe amount of frustration in the patient, may precipitate an immobilizing depression and requires a laborious teaching program to help overcome the basic handicap. Even with such extensive relearning there are many instances in which the aphasia is a permanent feature of the situation and is not correctible to a significant degree.

In the first 72 hours following the onset of an acute cerebral vascular accident the physician's problem is a relatively simple one. It is his function to keep the patient alive hoping that

a rehabilitation program will restore lost function at a later time. At this period the judicious use of fluids and electrolytes, antipyretic measures and sedation, avoiding those which depress respiration, and the proper management of associated cardiac disorders will occupy the physician's interests. Stellate ganglion block for a time enjoyed a degree of popularity as a means of minimizing the effects of a cerebral vascular lesion but in recent years this procedure has fallen into disrepute and it is not recommended. Oral or parenteral steroids are considered useful by many physicians in reducing cerebral edema, and preventing more extensive infarction of brain tissue than occurs from the primary vascular accident. The use of anticoagulant drugs is still a controversial topic despite extensive investigation but has in my experience proved useful early in the embolic cerebral vascular accident and in the less extensive thrombotic lesions. At one time repeated spinal punctures to reduce cerebrospinal fluid pressure and cerebral edema were widely advocated. The current concept is that only an initial diagnostic tap should be performed and that actually the use of repeated spinal punctures may be detrimental. The use of dehydrating drugs (i.e. magnesium sulfate etc.) scarcely seems worthwhile there being little or no physiologic basis for such usage.

If the patient survives the first 72 hours following the onset of the vascular accident the physician is now faced with the problem of his management during the convalescence and rehabilitation period. As the result of a cerebral vascular accident and particularly where spasticity develops as it does in the majority of cases, there is a tendency for the stronger musculature of the involved extremities to overpull the less powerful musculature into standard anatomic patterns. In the upper extremity this results in adduction, internal rotation and some degree of flexion of the shoulder joint, flexion and pronation of the elbow and forearm and flexion of the wrist, fingers and thumb. The thumb is usually

drawn into the palm and cannot be extended or abducted. In the lower extremity there is a tendency for external rotation of the hip to occur and the classic drop foot deformity with inability to dorsiflex, invert or evert the foot is common. If the patient is allowed to lie in bed in this position inevitably contractures of muscles and shrinkage of periarticular soft tissues will result and a permanent deformity in this anatomic position may occur in both the upper and lower extremity. It is therefore considered that the initiation of a bed positioning program as early in the course of the post-vascular accident period as possible is of utmost therapeutic importance. The simplest approach to bed positioning of the patient includes abduction of the shoulder by the use of an axillary pillow, some flexion to be preserved at the elbow since the majority of functional activities carried out by the upper extremity involve the use of the bent elbow near the 90 degree position and the maintenance of the forearm in pronation with the wrist propped up by a cock-up splint and the fingers maintained in slight flexion by the use of a bandage roll within the hand. The thumb should be allowed some abduction position but should be maintained sufficiently close to the palm of the hand so that the thumb and index finger may carry out pinching movements by utilizing their flexion power at a later date. A simple padded basswood splint with a bandage roll taped in position to properly dorsiflex the wrist and maintain finger function is all that is usually required for such bed positioning. In the lower extremity the hip is maintained in the neutral position, avoiding external rotation, by the use of sand bags at either side of the extremity and the foot may be maintained in dorsiflexion at the ankle by the use of either a footboard on the bed or by a posterior molded plaster splint well padded to avoid the development of decubitus ulcers of the heel. The position of choice is back lying but obviously the patient must be permitted to turn from side to side to

avoid the development of pressure areas on the back and buttock. As soon as proper bed positioning has been established the patient is placed on a program of passive exercises to the upper and lower extremity of the involved side designed to maintain the range of motion of all the joints and the resting length of the muscle bellies of all the involved musculature. This should be carried out at least twice daily for periods of about one-half hour. Muscle relaxant drugs have little or no value in reducing the spasticity of the involved musculature and electrical stimulation of the paretic limbs, while it may for a short period retard the development of muscle atrophy, serves no long term purpose in functional restoration.

The uninvolved upper and lower extremity are begun on a program of active exercises to increase strength and prepare the patient for future activities. As soon as neurologic restoration of function can be demonstrated in any muscle of the involved extremities a program of muscle re-education and strengthening is begun on a voluntary active basis and this is gauged primarily by the patient's strength and fatigability. Following a variable period of such bed activities the patient will be ready to begin gait training. This may be as early as 10 days to two weeks following the onset of the acute vascular accident. Gait training is begun in parallel bars. Should the patient manifest vertigo or postural hypotension it may be necessary to accustom him to the upright position gradually over a period of several days by the use of a so-called tilt table, a see-saw like arrangement permitting the patient to be moved from the horizontal position into various angles of verticality and accustomed gradually thus to the completely vertical position. If a persistent drop foot deformity is present a short leg drop foot brace will usually be required to enable the patient to walk successfully and, since the majority of such patients tend to assume the equinovarus position with the foot inverted, an outside T-strap usually

must be added to the brace. If the patient does not have adequate strength and control of the knee extensor muscles to permit standing unaided it may be necessary to fit him with a long leg drop foot brace with knee lock. However, such cases are unusual and the decision for the prescription of such a brace must be made with care. The added weight and loss of knee function which results when the brace is maintained in a locked position at the knee, may prove too much of a barrier for the patient to overcome in his ambulation activity. When the patient has learned to stand, balance and walk with his short leg brace in parallel bars he is begun on independent walking with a cane in the uninvolved hand. The primary emphasis in his re-training is placed upon safety and stability in walking rather than on the precision of the walking pattern. The patient then progresses from walking on flat ground to walking up ramps and eventually to walking on stairs. He is taught how to fall without injuring himself and how to arise from the ground without aid if he has fallen. At the same time a program of occupational therapy for the involved hand is begun attempting to teach him two-handed activities and the use of the involved hand at least for gross coordinate activities. If only partial recovery of function in the hand has occurred it may be necessary to use a dynamic hand splint to enable the patient to successfully utilize his remaining muscle power for functional purposes. Once the patient is capable of independent ambulation and has acquired as much skill in the involved hand as it appears can be re-trained into it, a program of self-care teaching is initiated usually designated as "the activities of daily living," technics which will enable the patient successfully to dress himself, feed himself, take care of his personal hygienic needs, perhaps to drive a car, to communicate by the spoken and written word utilizing the telephone or the typewriter as well as speech and, if he seems physically and intellectually capable of doing so, re-training him for

the occupational activities of his daily work within the limitations of his physical handicap.

The rehabilitation program of a hemiparetic patient who has had a cerebral infarction is a prolonged and sometimes frustrating one. The major gains which can be anticipated occur in the first six months of such a treatment program but further gains in functional capacity may be anticipated for a year and a half to two years after the onset of the initial lesion. In addition to the complications which have previously been mentioned which may tend to interfere seriously with the successful completion of such a rehabilitation program there are psychologic problems which occur not infrequently. These involve the development of dependency relationships between the affected individual and his or her spouse and other members of the family and the depressive reaction on a situational basis which is not uncommon. The average patient can be handled successfully by the practitioner if his prognosis is carefully explained to him and if realistic goals for his achievement are set based upon the degree of cerebral vascular disease and motor disability which is present. If the goals which are set for the patient are too high and hence unattainable he may, in complete frustration, reject the entire program and fail to make any progress at all. If the goals on the other hand are set at too low a level he may again refuse to cooperate because of

his disinterest in the achievement of simple mechanical success in minor activities. An evaluation of the psychologic and social factors in the patient's home environment are often essential before a proper therapeutic goal can be set by the physician.

The principles of management of the patient with a cerebral infarction have enjoyed considerable discussion in the medical literature of the past decade. Despite this it is disheartening to view in its broad perspectives the care of such patients currently practiced in our medical communities. Large numbers of such patients are still found in nursing homes suffering from contractures, decubiti, the inanition of inactivity and secondary personality disorders resulting from depression and frustration which may simulate senility even when it does not exist. The principles of management of such patients which have been briefly spelled out in this paper involves the basic concepts of physiologic and anatomic bed positioning, early mobilization, extensive muscular re-training and the re-teaching of functional activities within the limitations of the presenting disability utilizing the residual capacities and augmented by adaptive devices and braces. The majority of patients with a cerebral infarction can be restored to some degree of community and family living and no patient should be denied the privilege of such a management program.

Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



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The Management of the Patient with Arteriosclerosis Obliterans

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● The clinician has available to him a rather wide variety of therapeutic technics in the long term management of patients with arteriosclerosis obliterans. Many of these technics are useless and some actually may be detrimental to the welfare of the patient. Some of the technics are described. The patient requires scrupulous attention to the principles of cleanliness, warmth and avoidance of trauma. Drug therapy and sympathectomy have a very limited place in the management of this problem and are useful for only specific indications. Proper management of this condition will diminish morbidity and, even in the presence of the ultimate catastrophe of amputation, shorten the period of disability.

The patient with arteriosclerosis obliterans is an ever increasing phenomenon in this era of an aging population. In the absence of specific medication or methods of prevention for this disorder, scrupulously careful long-term management is essential to reduce morbidity to the minimum and to retard the progression of the secondary effects of the condition.

The clinical entity has been thoroughly documented: Intermittent claudication on exposure to cold or to activity of specific duration with relief by rest, and demonstrated trophic changes in the toes and the skin of the feet particularly detectable by the loss of hair over the dorsum of the toes, by thinning and flaking of the skin and frequently by mottled discoloration. In addition, the patient often complains of hypersensitivity to cold. He is found to have pale feet with impaired arterial pulsations, as measured either by palpation or by oscillometry and diminished skin temperature as measured by the thermocouple method or other skin temperature measuring device and often by alteration of sweat patterns of the lower extremities. Unfortunately not all cases of peripheral arterial disease of the arteriosclerosis obliterans type present

themselves in such a neatly categorized package. If the obstruction to arterial flow is at a high level, for example in the lower aorta or in the iliac arteries, the patient may have claudication of the buttocks and back rather than at the calf of the leg and may, therefore, complain of low back pain rather than of claudication. In such instances the arterial pulsations, as measured at the dorsalis pedis or posterior tibial vessels, may be quite misleading since the measurement may be within an acceptable border-line normal range even though physiologically the arterial circulation is grossly inadequate. The diagnosis of arteriosclerosis obliterans, therefore, must not be excluded because relatively normal peripheral pulsations in the arteries are detectable. This diagnosis must be based on a careful analysis of the trophic condition of the skin of the lower extremity, the arterial pulsations in the entire lower extremity as measured by oscillometry or similar technic and by the careful study of skin temperature which has been stabilized in a constant temperature room. If the physician has reason to suspect that circulation may be inadequate despite meager clinically detectable findings to support such a viewpoint he is perfectly justified in investigating further by the use of arteriography or aortography. Just as

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one cannot exclude the diagnosis of arteriosclerosis obliterans simply because peripheral pulsations appear to be present in the lower extremities, neither can one make the diagnosis simply on the absence of peripheral arterial pulsations. So called "pulseless disease" can occur in Monckeberg's sclerosis without any physiologic arterial insufficiency and without any development of morbidity as a result of arterial insufficiency.

When the diagnosis has clearly been established the management technics available, while limited, can be stated as simple principles. The master words are *cleanliness*, *warmth* and *protection from trauma*. Cleanliness as here defined implies more than simply the absence of dirt. It implies the protection of the skin from the detrimental effects of perspiration, moisture and excretory products as well as from the accumulation of skin tissue debris. The extremities should be washed at least once daily and preferably twice daily with lukewarm water and a bland (non-alkaline and non-medicated) soap. This should be followed by the application of an alcohol compound or mild astringent in order to toughen the skin somewhat and by the use of a lubricating substance such as petroleum jelly, lanolin or other oil-based substances to maintain skin texture intact. The physician must warn the patient to be extremely cautious in the use of heat in any form to the extremities and this must include even the temperature of the water with which he washes the extremity. If excessive heat in any form is applied to such areas of the body the increase in tissue temperature may produce an acceleration of local tissue metabolism far beyond the ability of the circulation to satisfy and may therefore tend to precipitate relatively severe arterial insufficiency with gangrenous changes in the toes. Local heating—whether dry or wet, whether by irradiation, contact or conversion devices in any form—therefore is strongly contraindicated. This ban should also be applied to devices, whether mechanical or electrical, utilized for warm-

ing the extremities in bed. The patient should be encouraged to wear clean absorbent socks, changing them twice daily and, if exposure to inclement weather is inevitable, should be encouraged to wear shoes with a warm lining of wool or synthetic material or, where this is not available, to cover the foot with a galosh. Shoes should be adequately contoured to avoid pressure areas and it may be necessary where deformities of the toes are present to have shoes custom made for this purpose since the best way to treat a superficial ulcer of the extremities is to avoid its development. It seems completely unnecessary to belabor the avoidance of circulatory impairments from extraneous sources such as garters, sitting with the legs crossed, or the use of stockings or socks held up by elastic bands. It also may seem superfluous to mention the fact that care of the toenails and corns which may be present are much better performed by a podiatrist than by the patient. Even minimal degrees of trauma to the tissues concerned should be avoided. It is essential that the physician call to the patient's attention that even the use of strong antiseptic solutions may result in skin burns with a catastrophic chain of events following. The use of tobacco in patients with a peripheral arterial disease of this type is perhaps still a controversial subject. If one presumes that no vasospastic element is present in this condition then the use of tobacco would not seem to be contraindicated. However, there does appear to be a moderate or minimal vasospastic element in many cases of arteriosclerosis obliterans and for complete safety avoidance of tobacco is a justifiable recommendation to the patient.

The use of physical therapy in the management of such patients has in the past utilized such a wide variety of modalities as to suggest their therapeutic futility. Physical therapy is more often abused than neglected in these problems. At one time intermittent venous occlusion by the use of alternating pressure cuffs was a popular approach

to the treatment of peripheral vascular disorders but this technic has not stood the test of time. Careful evaluation by the use of plethysmography has failed to substantiate the improvement in arterial circulation which was claimed for this method. In addition there is some reason to believe that the venous stasis produced may in some instances also be accompanied by arterial stasis with an increased tendency to the production of thrombi. Another method which was at one time quite popular was the so called pressure-suction boot of the Pavex type which instead of occluding the venous circulatory mechanism and producing a reactive hyperemia attempted to improve circulatory dynamics by the alternating application of negative and positive pressure through a suction boot. No significant physiologic benefits can be demonstrated for this method and it has long since been abandoned in most progressive clinics for peripheral vascular disorders. Two other technics have in the past enjoyed wide spread popularity and continue to be used in many areas. These actually are quite similar in their physiologic approach although utilizing somewhat different mechanical detail. They are the oscillating bed and Buerger's exercises. In both of these technics an attempt is made to alter hemodynamics by elevating the limbs until they are blanched then placing them in a dependent position until superficial rubor appears and following this with a varying period of rest, the alternating filling and emptying of the vessels being reputed to increase the arterial blood flow. There is much reason to doubt that these procedures actually produce significant alteration in hemodynamics and it is more likely that the symptomatic improvement which often is reported may be on the basis of the psychologic support which the patient gets from actually carrying out a specific treatment technic for his condition. A more recent mechanical device which has enjoyed considerable popularity utilizes vasopneumatic compression. Several such types of apparatus are available commercially and utilize a

series of rubber cuffs varying in number from seven to 14 which are progressively inflated in either a centrifugal or centripetal fashion so that a pressure wave is established tending to move either centrally or peripherally. The theory of such apparatus is that in the centripetal direction there will be a reduction of edema resulting from chronic lymphatic disorders or chronic venous insufficiency while in the centrifugal direction there will be a diminution of the degree of arterial insufficiency which is present. It is probable that such apparatus is of some value in reducing edema secondary to chronic lymphangitis or venous obstruction but it is extremely doubtful that it produces significant alteration in arterial blood flow. Massage has been used in the past as a method of increasing superficial blood flow through reflex vasodilatation. However, there is no reason to believe that such an increase in cutaneous blood flow actually helps the basic arterial circulation in the affected extremity and it may actually diminish the degree of tissue nutrition through vascular beds by removing from the deep tissues to more superficial pooled areas some of the circulating blood which is available. In addition the hazard exists that massage applied too enthusiastically may produce sufficient local trauma to initiate the very catastrophic series of events which the treatment is directed toward avoiding. As was mentioned earlier the use of local heating of the involved extremity always is contraindicated. However, there is some reason to believe that the application of heating technics to the abdomen and pelvis may result—particularly where some vasospastic tendency exists—in an increase in total peripheral blood flow with improvement in local tissue oxygenation and diminution of symptoms referable to arterial insufficiency.

Perhaps the therapy of greatest value to the patient is the continuation of activity within pain tolerance in the hope of developing increased collateral circulation. Walking should be carried out daily beginning first with walking

on flat terrain but subsequently utilizing carefully graded terrain of increasing steepness. The patient should be encouraged to walk to at least the point of pain before beginning to rest and to begin his walking activities again when pain disappears carrying it each time to the point of pain or just beyond this point. Continuous utilization of this technic eventually produces an elevation of the pain threshold and it has been demonstrated in many studies that such continuing activity tends to produce collateral vascular channels which may have a long term beneficial effect for the patient.

The use of specific drugs for the care of the patient with peripheral arteriosclerosis obliterans and the use of the surgical technic of sympathectomy may be considered together. The primary vasodilating drugs such as nicotinic acid, nicotinyl alcohol (Ronicol), and papaverine have enjoyed widespread and long term use in the treatment of peripheral arterial disease. In the particular entity under discussion in this paper, arteriosclerosis obliterans, it is felt that the primary effect of these drugs is simply a demonstration to the patient that superficial alteration in cutaneous blood flow can be made to occur. It is not felt that these therapeutic agents exercise sufficient alteration of vasodynamics to be of any benefit to the functional capacity of the extremity. The newer drugs currently used with some degree of popularity include tolazoline hydrochloride (Priscoline) and nylidrin (Arlidin). The action of these two drugs although believed by many physicians to be identical are actually pharmacologically dissimilar. Priscoline has complex actions serving as an adrenergic blocking agent but having in addition histamine-like action and a minimal degree of acetylcholine-like action. As a result Priscoline serves primarily as a chemical sympathectomizer and tends to produce some improvement in superficial cutaneous flow but it is actually of no great value for the treatment of intermittent claudication. However, even in patients who

have undergone surgical sympathectomy the polyphasic actions of Priscoline may be able to produce a minimal degree of vasodilatation. Arlidin on the other hand has as its primary action activity similar to that carried out by the sympathetic nervous system hence is of an adrenergic nature. Those blood vessels which are dilatable under the action of the sympathetic nervous system will respond to the effect of Arlidin and hence Arlidin finds its greatest usefulness in the management of claudication but may have detrimental and destructive effects in the patient with superficial ulceration and early gangrene. In both of these drugs it often is difficult to separate the psychologic symptomatic relief obtained by the patient from the actual physiologic effects.

Sympathectomy remains a controversial and in large measure unproven technic. In laboratory animals it often has been demonstrated that sympathectomy produces an improvement in cutaneous blood flow and that there may actually be a diminution of blood flow in deeper tissues. However, equally valid work by other authorities has tended to refute the application of this information to the human and has contended strongly that sympathectomy is therapeutically useful. In the last analysis the physician will be guided in his decision as much by the insistence of the patient and his family that something specific be done for the care of his condition as by the local surgical viewpoints of the institution in which he finds himself practicing. It is my personal opinion that if sympathectomy is to be done at all it should be done early enough so that whatever improvement in vascular dynamics can occur takes place before total occlusion of the peripheral vessels has occurred and secondly that when sympathectomy is carried out it be carried out as a high sympathectomy involving the first two to three lumbar segments and the last dorsal segment. Sympathectomy should not be done for the patient with intermittent claudication where it can serve little or no purpose but may be

carried out to increase cutaneous blood flow for the patient who has an ulceration or early gangrenous change. Where advanced gangrenous changes have already occurred sympathectomy will probably prove to be futile and may actually tend to accelerate the gangrenous process. Sympathectomy is relatively useless for the diabetic with peripheral gangrenous changes since these individuals are often self-sympathectomized as a result of the long standing effect of their metabolic disorder. Where the patient has developed a significant degree of pain at rest sympathectomy is rather strongly contraindicated unless an angiogram has demonstrated a reasonable degree of run-off into collateral circulatory channels.

Unfortunately in a depressingly large percentage of the patients with peripheral arterial disease none of the technics which have been described are of sufficient retarding value. The patient may progress rapidly to the state of complete arterial insufficiency in the lower extremities eventually developing gangrenous changes in one or more toes and ultimately reach the stage of amputation. Here the clinician still can offer to the surgeon useful management information. The well-trained surgeon should be oriented to the post-amputation care of the patient and his rehabilitation but in truth such orientation is often given lip service but is not used as a guiding principle in the surgical care of the presenting lesions. Amputation is not simply a method of disposing of dead tissue and removing from view offensive appearing ulcers, it is a method of preparing the patient for future living and activity and with proper management may eventually permit him to return to a reasonably full life while mismanagement may produce a permanently disabled individual. The site of election for amputation is probably the crucial key to this problem and the shaping of the stump is its corollary. The decision for the site of election must not be made purely on the expedencies of surgical technic but with the full rec-

ognition of the probability that this patient will ultimately be fitted with a prosthesis. This topic is actually too extensive for discussion in a paper of this type except to indicate that the most successful site of election for amputation if circulatory efficiency permits has usually been the junction of the lower and middle one-third of the tibia, although any site below the junction of the middle and upper one-third of the tibia is satisfactory. In the diabetic with good arterial pulsations but with gangrenous changes in one or two toes, a transmetatarsal amputation may offer a rapid solution with little or no residual disability. If the knee joint can be saved for the patient his ability to walk with a prosthesis will be greatly enhanced and the type of prosthesis required will be of greater simplicity and ease of application. However, it serves no useful purpose to preserve the knee joint if the stump below the knee is too short to act as an effective lever and if the residual stump musculature acting at the knee joint has been so badly destroyed by arterial insufficiency as to be non-functional. When amputation is considered above the knee it is essential that a decision be reached prior to surgery as to whether one plans to utilize an old fashioned cylindrical plug type of above knee prosthesis, the more modern quadrilateral prosthetic socket or even the more advanced suction type of socket. It is necessary to shape the stump properly and to judge its length accurately within relatively restricted limits for each of these prosthetic approaches and the decision must be made before surgery. Failure to establish the technical approach one plans to follow with such patients frequently results in an individual for whom no prosthetic device can be successfully adapted and who must really be considered a therapeutic failure in terms of both surgery and rehabilitation. Finally it is essential that the clinician who has been managing the problem of peripheral arterial disease and who plans to follow the patient through his prosthetic fitting and training be will-

ing to insist on revision of an unsatisfactory amputation stump. One of the most frustrating experiences in the rehabilitation care of such patients is attempting to fit a prosthetic device to a stump which is misshapen, which has healed incompletely and continues to drain or in which there exist painful neuromata or sharp protruding bony fragments. Despite the increased time delay which occurs when a revision of the amputation is carried out, the end results from a functional viewpoint will be superior and the time required for rehabilitation care will be appreciably shortened. It is not felt that the complex post-amputation management of such patients can be discussed at this time.

Conclusion

1. The clinician has available to him

a rather wide variety of therapeutic technics in the long term management of patients with arteriosclerosis obliterans. Many of these technics are useless and some actually may be detrimental to the welfare of the patient.

2. The patient requires scrupulous attention to the principles of cleanliness, warmth and avoidance of trauma.

3. Drug therapy and sympathectomy have a very limited place in the management of this problem and are useful for only specific indications.

4. Proper management of this condition will diminish morbidity and, even in the presence of the ultimate catastrophe of amputation, shorten the period of disability.

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**40th Annual Session, American Congress of Physical
Medicine and Rehabilitation. New York City, Hotel Commodore,
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The Medical and Social Outcome of 200 Respirator and Former Respirator Patients on Home Care

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and

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● The authors, a physician and a medical social worker, evaluate the medical and social outcome of 111 male and 89 female patients with residual involvement of respiratory muscles resulting from poliomyelitis. The methods, as well as the personnel, employed in conducting comprehensive studies in the patients' homes and in the respirator center on return visits are discussed. In this group of 200 individuals, the ages range from two to 46 years; 58 per cent are 20 years of age or older. The duration of time on home care ranges from less than one to five years or more. The majority of these patients are described as being severely involved; 64 per cent still require the use of mechanical breathing aids. The most frequent intercurrent medical problems are caused by upper respiratory infection. It is the authors' impression that these infections decrease in frequency as the patient's time on home care increases. The major medical problems arise from progressive scoliosis in approximately 32 per cent of the cases and the formation of renal calculi in 17 per cent. There are indications that in general the impact of home care has been more severe for the family members than for the patient. The criteria for measuring this impact, as well as some of the resulting disruptions are discussed at length. Totally aneic and quadriplegic post-poliomyelitis patients can be handled safely and comfortably in their own homes. It is concluded also that the success of the home program and the extent to which the patient resumes his former role in the family and society are based primarily on psycho-social factors rather than on the extent of the patient's physical disability and his medical problems.

In 1950 the National Foundation for Infantile Paralysis initiated the respirator center program. The purpose of this program was to provide intensive total medical care for the acutely ill poliomyelitis patient and to follow this by a complete restorative program based on achieving a maximum of physical and vocational rehabilitation within the confines of the patient's physiologic capacity.

From 1950 through 1959, 430 respirator patients were admitted at the Southwestern Poliomyelitis Respiratory and Rehabilitation Center, now a responsibility of the Texas Institute for Rehabilitation and Research. Following discharge of these 430 individuals to a home situation, some effort was made to maintain contact with them, but the initiative had been left primarily with the patient or his family. Early in 1957 visits were made by a physician and social worker to the

home of 55 patients for first-hand observation and study. This study indicated that a regular evaluation and follow-up program within the Center is necessary for the purpose of anticipating, preventing, and correcting the varied problems (social and psychologic, as well as medical) that develop during home care.

A comprehensive program of this nature was started later in 1957 at the Center for the purpose of taking a hard look at the medical, social and economic outcome of the respirator patient. This study is based on 200 respirator and former respirator patients who have been evaluated under the auspices of this program.

Table 1 illustrates that there were 111 males and 89 females in the group of 200 individuals studied. The ages ranged from two to 46 years with 61 per cent being 20 years of age and older. The duration of time from onset of poliomyelitis until this study ranged from eight months to 10 years with an average of 5.3 years. The individual average for the group on the home care program was 4.1 years. Twenty-two per cent of these patients resided within the general vicinity of the center; 60 per cent lived elsewhere in Texas at a distance ranging from 100 to 700 miles from the Center; and 19 per cent were

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located in Louisiana, Mississippi, Alabama, Florida, Oklahoma, Arkansas, New Mexico and Illinois.

Table 1: June 15, 1958 to June 30, 1959

AGE-YEARS	SEX	TOTAL
0-6	11 Boys 8 Girls	19
7-12	15 Boys 9 Girls	24
13-19	22 Boys 13 Girls	35
20-25	22 Men 15 Women	37
26-35	33 Men 31 Women	64
Over 35	8 Men 13 Women	21

Method

Approximately four patients on home care are admitted to the hospital each week for a period of five days (table 2). Each patient during this time undergoes a closely integrated, pre-scheduled comprehensive evaluation by the medical, medical social service, and

vocational counseling personnel of the Institute.

The medical coordinator of the program acts as the patient's responsible physician. He sees that the following are carried out: a medical evaluation consisting of a pertinent interval history note, a general physical examination, complete blood count, routine urinalysis, a battery of metabolic determinations, x-rays of the chest and abdomen, electrocardiogram, fluoroscopic examination for evaluation of respiratory muscle function, and detailed pulmonary air distribution studies.

Early in the course of hospitalization, the patient receives a detailed muscle check by the physical therapy department and a functional evaluation carried out by the occupational therapy department. Following this, the patient is seen by a member of the orthopedic

Table 2: Schedule for Follow-up on Respirator and Former Respirator Patients

Sunday P.M.	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Patient admitted	Soc. Service interviews 4 families Lab studies Fluoroscopy Electrocardiogram	Serial determination of vital signs for 24 hours (2 patients) Orthopedic & Physical Medicine Clinic with O.T., P.T., Assistive Devices, & Social Service Patients checked with all equipment	Pulmonary studies, pH, pCO ₂ , and O ₂ Determinations (4 patients) Assistive devices Fittings of corsets, splints, minor repair (4 patients) Psychologist and Orthotist to rotate patients	E & F* Conference Integration of all material Decision as to other treatments or evaluation procedures indicated Team reviews patients for following week Genito-Urinary Studies Genito-Urinary Clinic	Air distribution studies to patients, if necessary Final fitting of corsets, splints, etc. Discussion of findings and recommendations with patients and family by physician and Social Worker Discharge of patient if possible	Early discharge of patients not discharged Friday Appropriate information forwarded to local medical doctor, chapter, public health nurse and other interested individuals by physician and social worker
History and Physical	Intravenous Pyelogram (if necessary) Takes 2 hours Respiratory equipment to warehouse for check Social service sees 2 patients Physical therapist sees 2 patients Occupational therapist sees 2 patients Wheelchair check (2 patients) Assistive device check (4 patients)	Photo of all patients Physical therapist sees 2 patients Social Service sees 2 patients Occupational therapist sees 2 patients Wheelchair check (2 patients)	Prevocational functional testing Psychologist rotates with Orthotics Evaluation by Vocational Counselor Patients given tour of building if desired	Air distribution studies to patients, if necessary (2 patients) Breathing aid fitting measurement as necessary		

or physical medicine staff to check his problems with assistive equipment, functional muscle status and joint mobility. Surgical recommendations are made at this time if they are deemed necessary. Pertinent x-rays, particularly in those patients with scoliosis, are ordered to further evaluate the patient's status.

The urology department is requested to see the patient on consultation if the presence of kidney stones is noted on his routine abdominal x-ray or if he reveals increased pus cells in a urine specimen which is collected with essential aseptic technic. If needed, the urologist orders further investigatory x-rays and tests to complete the urologic evaluation.

Soon after the readmission of the patient, the medical social worker interviews him and also the responsible family members who have accompanied him. These interviews purposely are held separately in order that the patient and the family members may have the opportunity to express themselves freely regarding the problems encountered in home care and the adjustments that have either been required or indicated on the part of each. At the same time an effort is made to secure suggestions as to how the staff may have done a better job in preparing the patient, the family and the community for home care. The information obtained in these interviews has been pertinent and informative. The vocational counselor consults the patient with the purpose in mind of aiding and stimulating the patient toward a vocational goal within the patient's physical and intellectual capabilities. If the patient has been employed before the interview, then the vocational consultant seeks to get information as to the potentials of the vocation the patient is engaged in and aids him, if the patient needs further assistance toward his goals.

On the fourth day of the program, the entire team responsible for the evaluation of the patient meets in conference. At this time, each patient is discussed in detail and decisions are

made concerning any medical, social and vocational problems. Following the team conference, the patient and his family, the medical co-ordinator and the medical social worker have an interview where the results of this evaluation and decisions are discussed. The patient is discharged upon completion of his evaluation and upon receiving instructions or equipment recommended by the staff. As a rule it is recommended that such an evaluation be carried out annually.

Results

General Appearance. It is extremely gratifying that approximately 88 per cent of these markedly involved patients included in this study were happy, alert, and except for their neuromusculature defect, appeared to be in good health when seen. Seven per cent of the group revealed signs of varying degrees of stress and strain as noted by their cushionoid facial appearance with or without acne. The presence of the stress and strain phenomenon was confirmed in the majority of this latter group by polycythemia and an increased output of 17-hydroxycorticosteroids in the 24-hour urine specimen as well as a shortening of the systole in the electrocardiogram. In another five per cent, the medical problems were extremely varied. Four female patients returned for this type of evaluation in the first trimester of pregnancy and it is interesting to report that all four completed a nine month gestation period and were delivered of viable healthy infants.

Respiratory Status. Although each of these individuals had respiratory assistance during the acute illness, 33 per cent of those studied were completely weaned from all respiratory assistance, 59 per cent were receiving partial respiratory assistance, and eight per cent of the patients were receiving continuous respiratory assistance (fig. 1). The respiratory assistance received was by tank respirator, chest respirator, or rocking bed. Some patients used only one type of respiratory aid while others alternated between two or three.

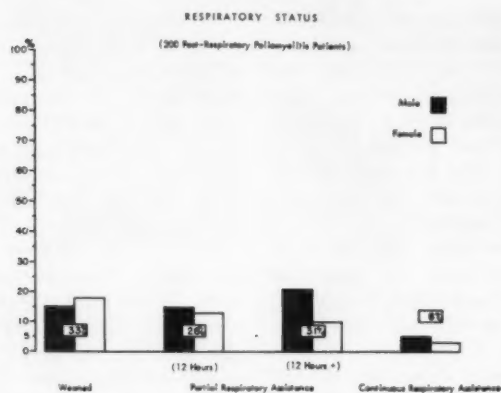


Fig. 1 — Respiratory status.

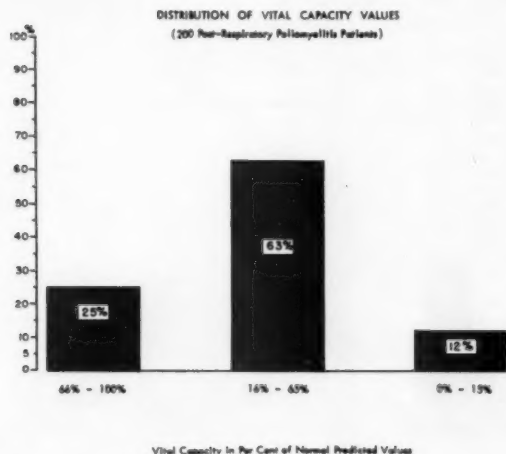


Fig. 2 — Distribution of vital capacity values.

A small percentage of the individuals used intermittent positive pressure in addition to one of the other breathing aids during the day. Glossopharyngeal breathing was engaged in when prescribed as an exercise or an additional assist for safety purposes.

No significant mechanical problems were reported in the equipment of the patients on home care and consequently there had not been any accidents due to mechanical failure.

Vital Capacity. The distribution of vital capacity values is shown in figure 2 as a per cent of predicted normal.

The predicted normals are based on body surface area. Twenty-five per cent are in the 66 to 100 per cent range; 63 per cent are in the 16 to 65 per cent range; and 12 per cent are in the 0 to 15 per cent range. Thus, a degree of correlation existed between the ranges into which the patients fell and their respiratory assistance.

Urinary Tract Status. The problems arising from renal calculi ranked next to respiratory infections as the major cause of complication in the severely involved poliomyelitis patient. Renal calculi not only serve as a focus for the

production of intermittent episodes of renal colic but also prohibit sterilizing the urinary tract (fig. 3). Only one patient with renal calculi in this group was free of urinary tract infection. Twelve per cent had unilateral calculi and six per cent had bilateral calculi. All patients except one had formation of stones within the first year following the onset of acute poliomyelitis. Of interest is the fact that only one patient who had poliomyelitis prior to the 10th year of life has developed stones.

Scoliosis. Figure 4 shows that 66 per cent of the patients revealed no scoliosis; 12 per cent had mild degrees; seven per cent were graded as moderate; and 15 per cent were graded as severe.

Prevention of scoliosis and treatment of those with slight curvature consists of proper positioning, corset, or Taylor back brace. Of the groups with moderate and severe scoliosis, approximately 60 per cent have undergone corrective measures. The correction of a few of these patients has been accomplished by the application of a Milwaukee brace, but the majority of them have undergone a spinal instrumentation* with or without spinal fusion. The remaining patients with severe scoliosis also had severe, multiple physiologic problems, thus causing an extensive surgical procedure to be too hazardous.

*The latter is a special surgical feature initiated by Dr. Paul R. Harrington of our orthopedic staff.

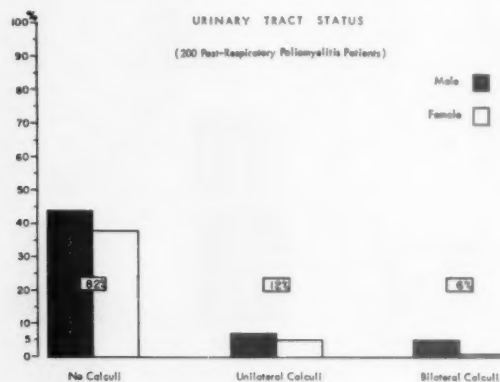


Fig. 3 — Urinary tract status.

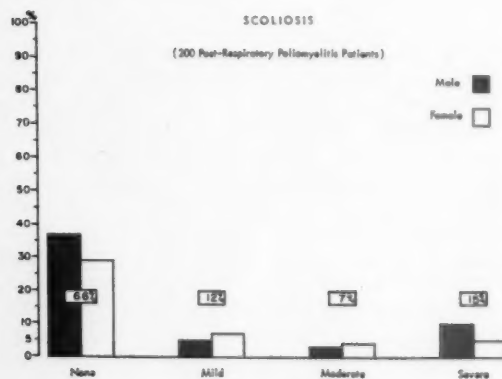


Fig. 4 — Scoliosis.

Approximately 12 per cent of the patients had either single or multiple joint contractures or deformities that required admission to the hospital either for vigorous physical therapy or surgical intervention for their correction.

Total Muscle Status. When these patients are ranked in respect to the resulting score on this muscle test a rather significant distribution is seen (fig. 5). Those individuals within the range of 0 to 150 muscle points were fully or partially dependent upon other persons. None of them could sit at more than 70 degrees. Those in the range of 151 to 400 muscle points had

severe limitation of activities of daily living; sat at 90 degrees; required full assistance for transferring; and depended on the wheelchair for moving activities. The individuals ranging from 401 to 600 muscle points were all ambulatory with assistive equipment but none of them were completely independent for activities of daily living. The group with the muscle score ranging between 601 to 1000 were all completely independent for activities of daily living. All were ambulatory either independently or with assistive equipment.

Figure 6 shows that in the upper extremities and stationary activities of

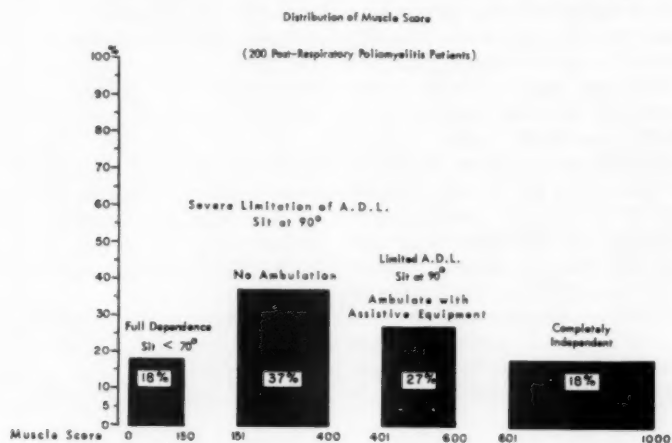


Fig. 5 — Distribution of muscle score (residual muscle strength and functional independence).

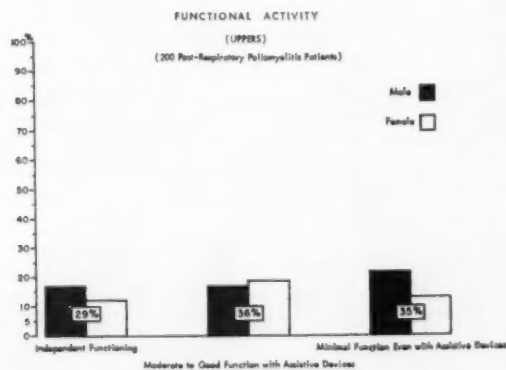


Fig. 6 — Functional activity (upper extremities).

self-care, 29 per cent of the individuals (17 boys-men and 12 women-girls) had completely independent hand and arm purposeful activities, exclusive of shoulders; 36 per cent of the individuals (17 men and 19 women) had moderate to good function with assistive devices; and 35 per cent of the individuals (22 men and 13 women) had minimal function of the uppers even with assistive devices. In many of these people this did not preclude some self-care, feeding, communication, etc., but an independent function scale placed their over-all status in a minimal group. Two of this group used a mouth stick, one for professional art work.

Figure 7 shows that in the lower extremities and moving activities 14 per cent of the individuals (seven men-boys and seven women-girls) were able to ambulate with complete independence; four per cent were able to ambulate safely with crutches and braces; 17 per cent of the individuals (nine men and eight women) were capable of voluntary standing for transfer and exercising but walking was judged to be too strenuous; 57 per cent of the individuals (32 men-boys and 25 women-girls) were able to be in a standard or high back wheelchair for most of their waking hours; and 21 per cent of the individuals (13 men and eight women-children) were in a reclining chair or

were able to be upright for meals only (some who used wheelchairs were included in this group).

Only five patients were bedfast and two of them were using the tank respirator continuously. In this group, categories were not mutually exclusive. The independent function 1000 point scale for stationary and moving activities used for these evaluations has real merit in following progress and regression of functional capabilities.

Medical Social Service Evaluation. The medical social service worker during her interviews with the patient and the family directed her questioning so as to determine the extent to which the patient was realizing some of the normal satisfactions of life and to evaluate the demands of the patient's physical and emotional condition on the family since this is probably the most significant evidence of whether or not the home care for the respirator patient is successful. The numerous factors considered in identifying the consequences of having a respirator or former respirator patient in the home include:

- (a) Stability and adequacy of family income.
- (b) Supportive physical environment.
- (c) Availability and adequacy of necessary personnel to render personal

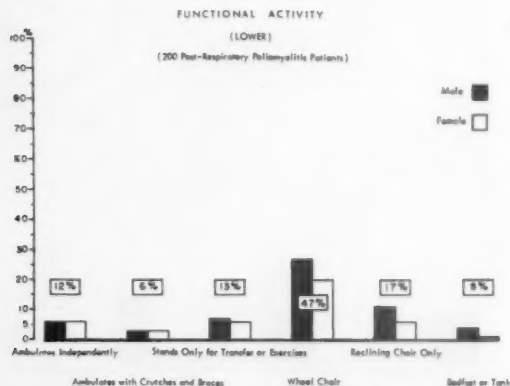


Fig. 7 — Functional activity (lower extremities).

service and care to the patient as well as to other members of the household.

(d) Existence and utilization of family and community resources.

(e) Suitability of family and patient's expectations relative to possible practical achievements of the handicapped person.

(f) Motivation to follow home care regimen.

(g) Patient's acceptance of his disability and its limitations.

(h) Family members' acceptance of patient's disability and its limitations.

(i) Degree of emotional maturity possessed by patient and by family members.

(j) State of dependence versus independence in patient and in family members.

(k) Status of interpersonal relationships within family group.

(l) Opportunities for normal life experiences for healthy family members.

(m) Comparison of role of individual family members (including patient) prior to and since patient's illness and return to household.

Overall the following results were found: in 38 per cent of the families there was relatively little evidence of unsuitable changes; in 43 per cent of the families there was moderate impact from home placement, but an acceptable adaptation had been made; in 17 per cent of the families there was severe disruption of the family's integrity; and in two per cent of the families there was a total devastation of the family's stability.

There are indications that in general the impact of home care has been more severe for the family members than for the patient. The evidence that 19 per cent of families had severe to total disruption is certainly a significant figure.

In 60 per cent of the cases it had been necessary for the family to employ additional help in order to provide the necessary personal care for the patient. Their means for financing this service came either from the family budget entirely or the family entered

into a participating agreement with some supporting organization.

Through a close study of these patients and their families we are acquiring knowledge and skills that will enable us to recognize signs and symptoms in individual situations that improve the accuracy of our prediction as to the success or failure of home care planning and the patient's ultimate adjustment to his disability. As a result of these statistics it may be considered as evidence that in many instances a suitable life existed for the patient and family. Supporting facts of this are less well appreciated and include the adequacy of the medical and social support by the Center to the patient, family and family physician. Undoubtedly, home attendants provide considerable stability to the family by permitting the release of bread winners for earning income.

Vocational Endeavors. As his first index the vocational rehabilitation counselor selected the educational and vocational status to reveal the sufficiency of the patient as an individual person. Nineteen of the patients were below school age and, therefore, were engaged in no educational activities. There were 55 youngsters ranging from seven to 18 years and all but two of these were continuing an educational program at elementary and high school levels. This was accomplished by either regular classroom attendance, orthopedic classes or homebound teaching programs.

There were 12 young people of college age attending college and three men of college age were attending vocational trade school.

Eighteen women were active homemakers essentially carrying out their pre-illness responsibilities. One person also had substantial earnings as a piano teacher. Six former homemakers had failed to resume their pre-illness family responsibility but two of these had incidental earnings which they contributed to the family income.

Thirty-five men had employment status (table 3); 17 were employed full-time with an annual wage ranging

between \$1,000 and \$20,000; 18 men were employed part-time with the annual income ranging from \$25 to \$1,500.

Table 3: Employment Status

Full Time		Part Time	
No. Patients	Annual Income	No. Patients	Annual Income
3.....	1,000- 2,500	1.....	0- 50
3.....	2,501- 4,000	1.....	51- 200
4.....	4,001- 5,000	6.....	201- 500
5.....	5,001- 9,000	7.....	501- 800
1.....	9,001-18,000	1.....	801-1,000
1.....	18,001+	2.....	1,001+
Total 17	Average Annual Income \$5,840	Total 18	Average Annual Income \$625

Conclusion

Totally apneic and quadriplegic post-polio myelitis patients can be handled safely and comfortably in their own homes.

The major problems arise from re-

spiratory infections, scoliosis, the formation of renal calculi, and stress and strain phenomena.

The mechanical maintenance of respiratory equipment in the home has been no problem.

The majority of the severely involved post-polio myelitis patients and their families are able to lead fairly normal and satisfactory lives when adequate preparations for home care have been made and good medical followup is available.

From the findings of this study it is concluded that the success of the home program and the extent to which the patient resumes his former role in the family and society are based primarily on psycho-social factors rather than on the extent of the patient's physical disability and his medical problems.

Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



Is life so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take, but as for me, give me liberty, or give me death!

—PATRICK HENRY

The Kim Self-Stander for Wheelchair Patients (A Self-Help Device)

Ki Ho Kim, M.D.
West Orange, N.J.

● For a quadriplegic to stand safely on a tilt board there must be two strong persons available to help him on and off the board. In this paper the author describes a standing device which eliminates the need for attendants and enables a quadriplegic patient, (level of the fifth, sixth, seventh and eighth cervical vertebrae) to achieve independence in standing; requires minimum assistance for the quadriplegic of the fourth and fifth cervical vertebrae level; eliminates the need for bilateral long-leg braces for the high cord level paraplegic patient who is not functionally ambulatory and has difficulty standing by himself, and enables non-ambulatory paraplegics who are ataxic or who have lost their sense of balance to stand independently without braces or other assistance. The machine operates electrically with a simple switch for up or down motion; it adjusts to fit individual patients; it stops automatically when the proper height is reached; it can be stopped anywhere along the cycle if the patient's position is wrong, and a properly fitted seat belt, arm crutches, etc., provide safety for the patient and a feeling of security.

The importance of standing for the quadriplegic and paraplegic patient is a well-established fact in the practice of rehabilitation. It usually is accomplished by means of a tilt board or long leg braces in the earlier phases of the program, and practiced continuously to prevent physiologic changes and to maintain the maximum physical status of the patient.

For a quadriplegic to stand safely on a tilt board, there must be two strong persons available to help him on and off the board. Bilateral long leg braces with some trunk support and either crutches or parallel bars are needed for a high cord level paraplegic to stand from a sitting position. While this assistance is available at the rehabilitation center, new problems arise for the patient when he goes home. He is faced with the financial difficulty of maintaining attendants, or the more frustrating problem of his family's inability to help him. To discontinue standing exercises hastens physiologic changes in the body, especially in the legs. I have been seeking the answer to these problems for some time now, and believe that this standing device best serves the needs of these patients by enabling them to stand independently.

The Importance of Standing

1. Standing provides range of motion

to the trunk and lower extremities and stretching exercise to the hips, knees, heel cords and trunk, thus preventing contractures.

2. It provides a prophylactic measure against calcium resorption from the bones which may lead to osteoporosis, pathologic fractures, bladder stone formation and renal damage.

3. Standing facilitates micturition.

4. It helps to prevent impairment of muscle tone due to deterioration of the stance reflexes and prevents generalized muscle weakness from decreased exercise tolerances.

5. It may prevent or overcome temporary loss of sense of balance, dizziness and syncope.

6. In standing, the weight is shifted from the sacrum, iliac-crests and greater trochanters which are the area most liable to develop decubitus ulcers and is borne on the heels and soles, giving the other areas a chance to recover and prevent decubiti formation.

7. The standing position stimulates the heart and blood vessels by demanding a somewhat increased cardiac output and vascular tone. It is thus a preventive and therapeutic measure against the postural hypotension which may result from prolonged recumbency.

8. Psychologic aspects are immediately apparent in providing a change of position, relaxation, an escape from boredom of constantly being in a wheelchair, a feeling of independence from actually participating in the changing of position and an opportunity to participate in avocational interests while standing. The patients experience a new outlook from the standing position even though they have no real basis for expecting to walk.

From the Kenner Institute for Rehabilitation.

Characteristics of Standing Device

1. Eliminates need for attendants, enabling quadriplegic patients, (level sixth, seventh and eight cervical vertebrae) to achieve independence in standing.
2. Requires minimum assistance for quadriplegic (level of the fifth and sixth cervical vertebrae) to stand.
3. Eliminates the need for bilateral long-leg braces for the high cord level paraplegic patient who is not functionally ambulatory and has difficulty standing by himself.
4. Enables non-ambulatory paraplegic who is ataxic or has lost his sense of balance to stand independently without braces or other assistance.

Operation of Standing Device

1. Machine operates electrically with a simple switch for up or down motion.
2. It adjusts to fit the individual patient.
3. It stops automatically when the proper height is reached.
4. It can be stopped anywhere along its cycle if the patient's position is wrong.
5. A properly fitted seat belt, arm crutches, etc., provide safety for the patient and a feeling of security.

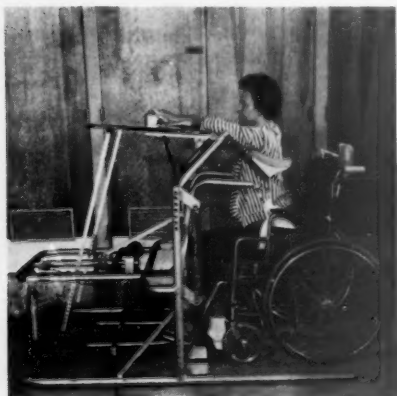


Fig. 1 — Quadriplegic patient in sitting position with chair sling hooked to Kim Self-Stander.



Fig. 2 — Patient in process of being brought to a standing position.



Fig. 3 — Full standing position without braces. Table may be used to suit patient's abilities.

Cost and Source

1. The standing device sells for slightly more than the cost of bilateral long-leg braces. The machine sells for approximately \$495.
2. Source: Franklin Hospital Equipment Corporation, 116 Academy Street, Newark 2, New Jersey.

Instructions

When the machine is delivered to the patient, the automatic switch and height of the knee support and width of the arm support are adjusted ac-

cording to the patient's need. The following are the instructions for operating the machine:

A. Independently (figs. 1-3).

1. Before the patient transfers into the wheelchair, the buttock strap is placed on the seat so as to be centered on the ischial tuberosities. (A seat cushion with buttock straps attached is used.)

2. Patient brings the wheelchair to within 12 to 18 inches of the foot stirrups.

3. Patient swings foot rests outward.

4. The wheelchair is advanced to allow the feet to fully enter the stirrups and the knees to enter into the knee supports.

5. Patient hooks the rings of the buttock strap onto the elevating lever arms.

6. With the patient holding onto the horns of the machine, the switch is placed in an "up" position.

7. The machine will shut off automatically when the patient is standing in an upright position.

8. To sit down, reverse the procedures.

B. One person assisting.

1. Before the patient transfers into the wheelchair, the buttock strap is placed on the seat so as to be centered on the ischial tuberosities. (A seat cushion with buttock straps attached is used.)

2. Remove foot pedals of wheelchair.

3. Push patient in toward the stander table, with knees into knee supports and feet into the stirrups.

4. Hook rings of buttock strap onto the hooks on the elevating lever arms.

5. Place axillas of patient on the horns of the stander, protecting the patient's chest from the table extension if necessary.

6. Throw the switch to an "up" position. (It takes approximately 45 seconds to come to a full standing position.)

7. Check patient's legs while rising to see that the feet do not come out of the stirrups.

8. Check tightness of the buttock strap to prevent hyperextension of the patient's trunk.

9. To sit down, reverse the procedures.

Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



Some Observations on Bell's Palsy in Belfast During the Period 1949 to 1958

Dr. George Gregg
Belfast, Northern Ireland

● The anatomy, pathology and treatment of Bell's palsy are discussed and certain characteristics are examined in the 661 patients treated at the Royal Victoria Hospital, Belfast, during 1949 to 1958. It is estimated that the average annual incidence of Bell's palsy in Belfast is 160 cases per million of the population. The data give no evidence of the condition being relatively more often affected than the other. Of the patients treated 29 per cent had their sense of taste and two per cent their sense of hearing involved while the Ramsay Hunt syndrome was present in three per cent.

All but 20 patients responded to treatment and of the 641 that did so, 484 (73%) are considered to be "cured" and 157 (27%) "improved." There is no evidence that sex or side affected influenced the cure rate, but the cured group were on average five years younger than the improved. Of the cured patients 73 per cent had symptoms lasting for less than 10 days before treatment began compared with only 63 per cent of the improved; only three per cent of the cured had symptoms for more than 50 days compared with as many as eight per cent of the improved. Treatment was completed in less than 30 days for 70 per cent of the cured compared with only 35 per cent of the improved. Interpretation of this difference is difficult because of the tendency to extend treatment of the improved in the natural desire to achieve cure. Attempts were made to estimate the association between durations of symptoms and treatment.

In 1821, Charles Bell recognized a peripheral form of facial paralysis which is characterized by its sudden onset without any apparent cause.

The anatomy and pathology of the facial nerve. The motor nucleus of the facial nerve is in the central part of the tegmentum of the pons. Fibers from these cells form a loop around the nucleus of the sixth cranial nerve to emerge from the pons medial to the eighth nerve. The seventh and eighth nerves, together with the pars intermedia of Wrisberg pass to the internal auditory meatus where the seventh nerve and the pars intermedia enter the facial canal in the petrous temporal part of the temporal bone. During this part of its course it passes sharply backwards and downwards on the medial side of the middle ear and emerges at the stylomastoid foramen. At the backward curve is situated the geniculate ganglion which receives the pars intermedia and contains the ganglion cells of the taste fibers of the chorda tympani. Within the facial canal the nerve to the stapedius muscle is given off. From the stylomastoid foramen the facial nerve moves forward to divide within the

substance of the parotid gland forming branches which innervate the muscles of facial expression.

The pathology is well described by Kettel,¹ "Bell's palsy is in all probability a pathogenic entity, the primary and central feature of which is a 'dysregulation' of the circulation which probably takes place near the stylomastoid foramen causing an ischaemic paralysis. The consequence of the lack of blood supply to the nerve is edema with subsequent degenerative changes, the nerve is thus compressed in its bony canal, which causes further impairment of the vascular blood supply; so that a vicious circle arises, the process being reversible."

Surgeons having experience with the facial nerve (Ballance and Duel,² Cawthorne,³ Kettel,¹ and Sullivan⁴), all noted that on decompression of the nerve near the stylomastoid foramen the nerve sheath is constricted near the stylomastoid foramen and the nerve proximate to this place edematous.

The Belfast Data

During the 10 years from 1949 to 1958 some 700 patients, with a confirmed diagnosis of Bell's palsy, were treated at the Royal Victoria Hospital in Belfast. The records of almost all patients contain the following information:

1. Age of patient at first attendance at clinic.
2. Sex.
3. Side of face affected.
4. Date patient first attended clinic.
5. Patient's estimate of duration of symptoms before first attendance at clinic.
6. Duration of treatment.

From Royal Victoria Hospital, Department of Physical Medicine; The Northern Ireland School of Physiotherapy; The Dental School, Queen's University; Consultant Physician in Physical Medicine, Belfast Hospitals Management Group and Forster Green Hospital.

Read at the 3rd International Congress of Physical Medicine, Session on Diseases of Skeletal Muscle, Washington, D. C., August 23, 1960.

7. Whether or not (a) taste, or (b) hearing was affected.
8. Presence of the Ramsay Hunt syndrome.
9. Result of treatment.

During the whole period subjective decisions involved in these items were made by one physician, but unfortunately the records of about 40 patients seen in the first half of 1957 were not available for analysis. Apart from this loss, there is no reason to suppose that this series is not representative of all the patients who required treatment for Bell's palsy in Belfast during these 10 years. There were 661 records available for analysis.

Treatment of patients. The procedures employed with physical therapy of Bell's palsy are local heat, electrical stimulation, massage and splinting. Local heat is used to prepare the muscles for electrical stimulation and massage in the form of an infrared lamp. The simplest stimulating current is the interrupted direct current. Progressive atrophy and intramuscular fibrosis can be reduced but not prevented by regular, adequate stimulation (Fischer,⁵ Guttmann and Guttmann,⁶ and Jackson⁷).

All the patients attending the Department of Physical Medicine were told to attend daily for six days a week for interrupted galvanism; as recovery took place, facial movements were demonstrated and practiced. In those patients with marked deviation of the angle of the mouth, small plastic splints were made by members of the Dental Department. Massage was reserved principally for those patients who showed some degree of hemispasm or facial contracture whether they had received electrical stimulation or not. Electrical stimulation was stopped in every case where any tendency to show contracture occurred.

Statistical treatment of the data. In making comparisons between sub-groups of patients it has been necessary to employ statistical tests of significance in order to estimate the probability of observed differences between sub-groups being due to chance. The results of such tests usually have been shown as foot-

notes to tables 1 through 8, but occasionally they appear in parentheses in this text.

The conventional criterion of statistical significance has been used. This has the effect of describing results that are unlikely to arise by chance more than once in 20 trials ($P < 0.05$) as "significant." This word has only been used for this purpose; thus a significant result is not necessarily clinically important. Moreover, if a result is "not significant" it is not necessarily clinically unimportant; it may be that the data are too few to reveal a clinically important result.

Frequency of onsets — general trend. The date the patient first attended the clinic and his or her estimate of the duration of symptoms have been used to make an estimate of the date of onset of 656 of the 661 cases. Information in the other five was considered unreliable.

Figure 1 shows the frequency of estimated onsets in successive four week periods from Jan. 1, 1949, to Dec. 20, 1958. It will be appreciated that the true number of onsets in the late months of 1956 and 1958 probably are understated in this diagram because information about patients seen early in 1957 and 1958 could not be considered.

The number of onsets in each year from 1949 to 1956 was 52, 77, 76, 56, 61, 74, 68 and 77; there were 33 in the last half of 1957 and 82 in 1958. The size of the Belfast population was, on an average, about 0.44 millions during the 10 years, so that the average annual onset rate is about 160 per million and the rate has fluctuated between 120 and 190 per million with no definite upward or downward trend. These rates must, of course, be considered as minimal estimates unless it can be assumed that all patients with this condition are referred to this clinic.

Frequency of onsets — seasonal variation. Figure 2 shows the estimated onsets in each calendar month for each year in 1949 to 1955, arranged so that the possibility of seasonal variation can be readily examined. Onsets in and after 1956 have been excluded because, for reasons already given, the estimates

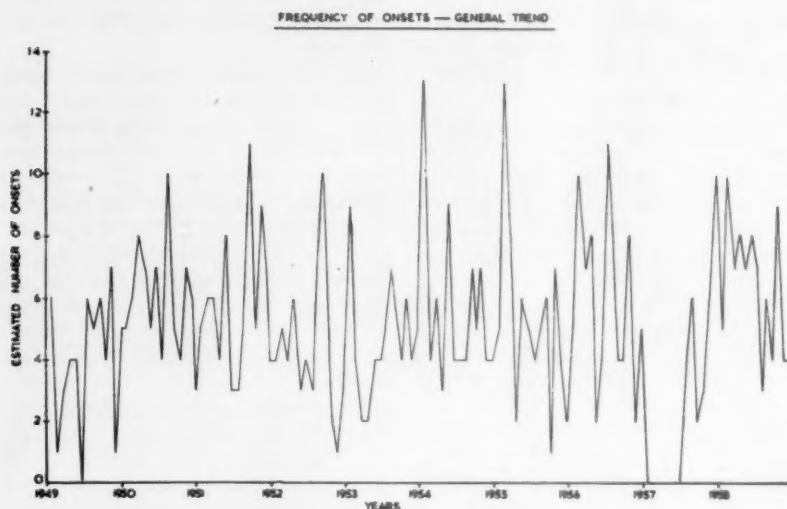


Fig. 1

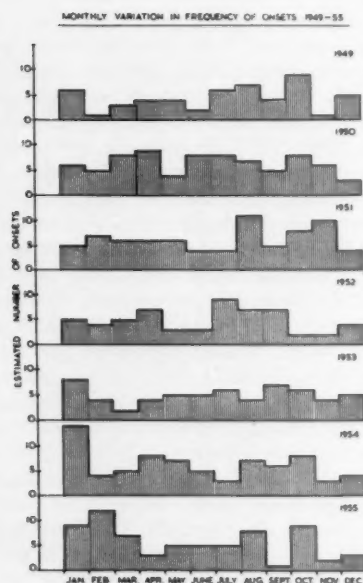


Fig. 2

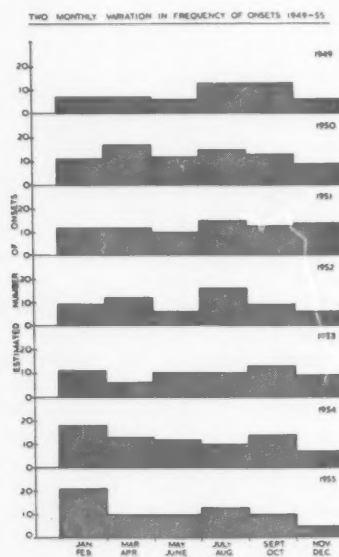


Fig. 3

made for the later months of 1956 and 1958 are unreliable and those for early months of 1957 not available.

The figure suggests that in some years (1953, 1954 and 1955) January or February were the months when most onsets occurred whereas in other years

the maxima occurred in various months after July.

In figure 3 the previous diagram is smoothed by using two month periods. This suggests a bimodal distribution in most years; peaks are apparent in the periods January to April and again in

Table 1: Distribution of Patients by Sex and Side Affected

Sex	Side		Total
	Right	Left	
Male	165 (52)	151 (48)	316 (100)
Female	179 (53)	156 (47)	335 (100)
Total	344 (53)	307 (47)	651 (100)

(1) $\chi^2 = 0.1$, D.F. = 1, $0.8 > P > 0.7$

(2) Figures in brackets are percentages of sex totals.

Table 2: Distribution of Patients by Sex and Result of Treatment

Sex	Result		Total
	Cured	Improved	
Male	244 (50)	67 (43)	311 (49)
Female	240 (50)	90 (57)	330 (51)
Total	484 (100)	157 (100)	641 (100)

(1) $\chi^2 = 2.8$, D.F. = 1, $0.1 > P > 0.05$

(2) Figures in brackets are percentages of "result" totals.

Table 3: Distribution of Patients by Side Affected and Result of Treatment

Side	Result		Total
	Cured	Improved	
Right	259 (54)	78 (51)	337 (53)
Left	218 (46)	76 (49)	294 (47)
Total	477 (100)	154 (100)	631 (100)

(1) $\chi^2 = 0.6$, D.F. = 1, $0.5 > P > 0.3$

(2) Figures in brackets are percentages of "result" totals.

Table 4: Distribution of Patients with Complete Records by Sex, Side Affected and Result of Treatment

Side & Sex	Result		Total
	Cured	Improved	
Right			
Male	125	32	157
Female	130	41	171
Left			
Male	107	29	136
Female	104	42	146
Total	466	144	610

July to October. One might speculate that as the years passed the earlier peak became more important, but the numbers are too small for such a conclusion to be drawn with confidence.

Sex distribution. Of the total 661 patients, 321 (49%) were males and 340 (51%) were females. This certainly does not suggest that either sex is at a greater risk of being affected. The observed distribution does not differ significantly from that expected if 50 per cent of patients were of the same sex ($\chi^2 = 0.5$, D.F. = 1, $0.5 > P > 0.3$). The data available about the sex ratio of the population exposed to risk do not permit a more precise test than this.

Side affected. In all but seven of the 661 records the side of the face affected was noted. Of the 654 concerned, 344 (53%) were affected on the right, 307 (47%) on the left and three (less than 0.5%) on both sides. The 651 unilateral cases give no support to a hypothesis that one side is more commonly affected than the other; the observed distribution is not significantly different from that expected if each side was equally affected. ($\chi^2 = 2.1$, D.F. = 1, $0.2 > P > 0.1$). It is possibly of interest to note that with a series of this size, had the proportion affected on one particular side been 54 per cent or more, a significant departure from the theoretical 50 per cent expected would have been achieved; thus, on these data alone, it might be unwise to completely dismiss a theory of the right being more commonly affected than left side.

Table 1 shows the distribution of the 651 patients, who were unilaterally affected, by side affected and sex, and the data offer no evidence of any association between sex and side affected.

Patients with hearing and/or taste affected. Of the total 661 patients as many as 191 (29%) reported that their sense of taste was impaired. The proportion was slightly higher among women (31%), than among men (27%) and slightly greater among patients affected on the right side (31%) than among those affected on the left (27%). But these differences are not significant.

In only 12 (2%) of the 661 records was hearing reported as being affected and six of these 12 patients also reported that their sense of taste was affected.

Ramsay Hunt Syndrome

This syndrome was present in 19 (3%) of the 661 patients, 12 were males and seven females; 10 were affected on the left and nine on the right side.

Results of treatment. After treatment all patients were classified as "cured" or "improved" with the exception of 20 who failed to continue their treatment. Of the 641 with a definite result, 484 (76%) were considered to be cured and the remaining 157 (24%) were improved.

The two groups, cured and improved, had much the same sex distribution (table 2) and much the same distribution by side affected (table 3). Thus these data offer no evidence that sex or side affected are factors influencing the results of treatment.

Age, duration of symptoms and of treatment. It is of interest to consider these three variables together with particular reference to the two groups of patients, cured and improved. Because the ages and durations were considered to be likely to interact with each other the remainder of this analysis is limited to 610 records which are complete in all details. The three bilaterally affected cases are excluded and the other 48 excluded cases include the 20 for whom no result is available, the seven for whom there is no record of affected side, 13 with no known age, five with no duration of symptoms and three with no duration of treatment on record.

Table 4 shows the composition of the 610 patients whose records are analyzed. It is hoped and thought likely that the omissions, which represent only about seven per cent of all cases, will not invalidate the conclusions.

Age of onset. A preliminary analysis of the ages of onset revealed significant differences in mean age between the eight groups identified in table 4. On inspection these were found to be largely due to the patients who were ultimately cured being, on average, significantly

Table 5: Distribution of Patients by Age of Onset and Result of Treatment

Age in Years	Result		Total
	Cured	Improved	
0 - 19	76 (16)	17 (12)	93 (15)
20 - 29	119 (42)	34 (35)	153 (40)
30 - 39	113 (66)	23 (51)	136 (63)
40 - 49	59 (79)	25 (69)	84 (76)
50 - 59	54 (90)	22 (84)	76 (89)
60 - 69	30 (97)	18 (97)	48 (97)
70+	15 (100)	5 (100)	20 (100)
Total	466 (100)	144 (100)	610 (100)

(1) $\chi^2 = 11.9$, D.F. = 5, $0.05 > P > 0.02$

(2) 60-69 and 70+ taken as one group for χ^2

(3) Figures in brackets are cumulative percentages of "result" totals.

Table 6: Observed and Expected Distribution of Patients by Age of Onset

Age in Years	Observed	Expected
0 - 19	93	223
20 - 29	153	84
30 - 39	136	78
40 - 49	84	76
50 - 59	76	64
60 - 69	48	45
70+	20	38
Total	610	610

(1) $\chi^2 = 179.8$, D.F. = 6, $P < 0.001$

(2) Expected distribution based on age distribution of general population.

younger by about four years than those who were ultimately improved. Table 5 shows the distribution of the ages of onset of both these groups and shows that the cured group included relatively more young persons than did the improved.

If the 610 patients had been distributed by age in the same proportion as holds for the general population in Belfast, the "expected" distribution in table 6 would have been the approximate result. The observed distribution is significantly different from that expected and emphasizes the age group 20 to 39 as that of the highest apparent incidence. Again caution is required in interpreting this as a "true result" because to make it so the sample must be unselected in the matter of age.

Duration of symptoms. There were no significant differences in the average duration of symptoms between the eight

Table 7: Distribution of Patients by Duration of Symptoms and Result of Treatment

Symptoms Duration, Days	Result		
	Cured	Improved	Total
0 - 4	176 (38)	56 (89)	232 (38)
5 - 9	165 (73)	35 (63)	200 (71)
10 - 14	61 (86)	19 (76)	80 (84)
15 - 20	38 (94)	8 (82)	46 (91)
30 - 49	13 (97)	15 (92)	28 (96)
50+	13 (100)	11 (100)	24 (100)
Total	466 (100)	144 (100)	610 (100)

(1) $\chi^2 = 25.7$, D.F. = 5, $P < 0.001$

(2) Figures in brackets are cumulative percentages of "result" totals.

Table 8: Distribution of Patients by Duration of Treatment and Result of Treatment

Treatment Duration, Days	Result		
	Cured	Improved	Total
0 - 9	78 (17)	15 (10)	93 (15)
10 - 19	169 (53)	21 (25)	190 (46)
20 - 29	80 (70)	14 (35)	94 (62)
30 - 49	54 (82)	15 (45)	69 (73)
50 - 99	39 (90)	27 (64)	66 (84)
100 - 149	27 (96)	24 (81)	51 (92)
150+	19 (100)	28 (100)	47 (100)
Total	466 (100)	144 (100)	610 (100)

(1) $\chi^2 = 83.8$, D.F. = 6, $P < 0.001$

(2) Figures in brackets are cumulative percentages of "result" totals.

sub-groups of table 4. For the complete series of patients the average duration of symptoms before attending the clinic for the first time was 16 days, but there was considerable variations between patients, as table 7 shows. Seventy-one per cent of the patients attended within 10 days of onset of symptoms, but the distribution is very skew and some patients had symptoms for a year or more before they came to the clinic.

These skew distributions make comparisons of means misleading; therefore cured and improved patients have been compared in table 7. This table shows a significant excess of relatively long durations (15 days and more before being seen) among "improved" patients, which is balanced by a relative excess of the five to nine days durations among the cured. If it is assumed that both sets of patients are comparable in all relevant respects and that further treatment would not have resulted in improved patients

becoming cured, then these differences in duration of symptoms suggest that best results are likely to be achieved if patients start treatment soon after onset. No comments can be made on the second assumption, but with regard to the first, it should be noted that of the points so far examined only age appears to be associated with results of treatment. There is, however, very little evidence of a relationship between age and duration of symptoms. Correlation coefficients (r) calculated between age and duration of symptoms in each of the eight sub-groups of table 4 never gave a value for r greater than 0.25 and only one of the coefficients was significant.

Duration of treatment. A preliminary analysis of the mean durations of treatment showed significant differences between the eight sub-groups of table 4; these were due to a mean difference of some 54 days in treatment between the patients ultimately cured and improved. The cured group were treated on average for 34 days and the improved group for 88 days. As table 8 shows there was considerable variation about these averages. Some patients were being treated for as long as nine months in the cured group and 15 in the improved group. Of the patients ultimately cured 50 per cent were treated for 20 days or less whereas only 25 per cent of those improved were treated for so short a time.

There was no evidence of any important relationship between age and length of treatment in any of the sub-groups of table 4. (There were four significant correlation coefficients varying from $r = 0.19$ to $r = 0.38$.) Nor was there any evidence in the form of high correlation coefficients of an association between duration of symptoms before treatment and duration of treatment.

However, the interpretation of the data relating to duration of symptoms and duration of treatment is difficult for a number of reasons. Firstly, the skew distribution of the former variable makes the correlation coefficient an inappropriate measure of possible association. Secondly, the patients classified as

improved were often treated beyond the stage at which improvement was reached in the hope of achieving a complete cure. Thus duration of treatment in the improved group has no useful meaning and cannot be sensibly analyzed because for any one patient it consists of two unknown components — the time taken to achieve improvement plus the time taken in attempting to achieve a cure.

Bierman⁸ demonstrated that intensive daily treatment for the first two weeks followed by treatment three times weekly resulted in 69 per cent recovery in four weeks and a 90 per cent recovery in twelve weeks. When physical therapy was given three times weekly, the four week recovery was only 38 per cent and the twelve week recovery rate was 72 per cent. In 26 weeks the recovery rate was 92 per cent, approximately the figure of 90 per cent accomplished by the more intensive therapy in 12 weeks.

In this series by the end of four weeks treatment 327 cures and 50 improvements were recorded, giving a rate of 54 per cent for cures alone and 62 per cent for cured and improved together. By the end of 21 weeks of treatment 447 patients were completely cured and 116 improved, giving rates of 73 per cent and 92 per cent for cured alone and

cured and improved combined.

Acknowledgments: The majority of these patients were referred to the Department of Physical Medicine through the courtesy of my medical and surgical colleagues. The collation of the various facts and their presentation has been due to Dr. E. A. Cheeseman, Mr. J. D. Merrett, Mrs. D. Hutton and Miss B. Thornbury of the Department of Social and Preventive Medicine, Queen's University, Belfast. I am deeply grateful to all those who have assisted me in the management of these patients and in the preparation of this paper.

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



There is no rest for a messenger till the message is delivered.

—JOSEPH CONRAD

(Teodor Jozef Konrad Korzeniewski)

Lethal Effects on Several Common Dermatophytic Fungi by Ultraviolet Light After Exposure to Compounds of the Furocoumarin Group

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● This project is designed to determine whether *Trichophyton Rubrum*, a common source of fungus infections in humans, can be effectively killed with ultraviolet light after exposing the organism to various furocoumarins. A definite enhancement of the lethal effect of ultraviolet light through the photosensitization of various bacteria and fungi with several furocoumarin compounds has been noted by a group at the University of Oregon Medical School under Fitzpatrick. Their work was primarily investigating the melatonin stimulating effect of ultraviolet light, and no investigation of the potential use of this method in treating fungus or bacterial infections has been undertaken to date. This project is aimed at investigating such potential.

The furocoumarins have received much attention in many recent investigations, and the broad scope of their biologic activity has been shown. In investigating phenomena relative to photosensitization, Fowlks, Griffith and Oginsky¹ showed that certain furocoumarins were highly effective in sensitizing certain bacteria to ultraviolet light. The potential clinical applications of this phenomenon are limited because of ultraviolet light's poor penetration of human tissue. However, many superficial fungus infections of human skin lie within the zone of ultraviolet penetrability.² The authors felt that an investigation of fungicidal effects of ultraviolet light upon dermatophytic fungi after exposure to photosensitizing agents might lead to a treatment of certain chronic fungus infections of human skin.

I. Screening Technics to Distinguish Compounds Worthy of Further Study

Initially, a wide variety of potentially photosensitizing agents were screened against five common dermatophytes (*Trichophyton Rubrum*, *Trichophyton Mentagrophytes*, *Microsporum Gypseum*, *Microsporum Canis*, and *Epidermophyton Flocculosum*).³ Method used was as follows: Whatman No. 2 filter paper discs, six millimeters in diameter were

impregnated with 100 micrograms of the compound to be tested. The discs were then placed on a freshly solidified layer of Sabouraud's Peptone agar (Difco), approximately two millimeters deep in a 10 centimeter Petri dish. A six milliter layer of melted agar inoculated with a saline suspension of mycelia was then poured over the discs. The mycelial suspension was prepared by scraping approximately .5 square inches of colony growth from a vigorous slant of the organism. The scrapings were ground briefly with a mortar and pestle, and were mixed with 10 cubic centimeters of normal saline. Two-tenths of a cubic centimeter of suspension to each 10 cubic centimeters of agar usually produced growth of the desired density. After a three hour period to allow for diffusion of the compound, the plates were uncovered and exposed to a Glo-Craft No. 70 lamp (Switzer Brothers Inc., Cleveland, Ohio) for 15 minutes at 15 centimeters distance. The Glo-Craft lamp has been calibrated with a ferri-ferrous reduction actinometer and found to have an output of 4.5×10^{16} quanta per second. Its principal output is at 3654 Angstrom units. Incubation at room temperature followed until sufficient growth appeared to demonstrate zones of inhibition around each disc. Identical plates without the radiation

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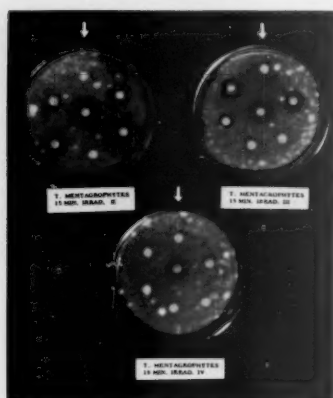


Fig. 1

served as controls. The areas at the periphery of the plates received the ultraviolet radiation but did not receive any appreciable amount of photosensitizing compound. We feel these areas represent controls for evaluating the effects of ultraviolet alone. The control plates with identical preparation, but not irradiated, showed normal uninhibited growth except for areas near discs impregnated with Psoralen-quinone and Thio-coumarin. Psoralen-quinone showed mild antifungal activity against all tested organisms. This was unaffected by radiation. Thio-coumarin showed similar unaffected activity against Epidermophyton Flocculosum and Microsporum Gypseum. Most plates could be read at 96 hours. The diameter of the zone of inhibition is not a true measure of the effectiveness of the compound, since its concentration in the agar is a

function of its diffusibility. The results are tabulated in table 1 and figure 1.

II. Investigation of Specific Activity of 8 Methoxypsoralen

Because of its effectiveness and availability, 8 Methoxypsoralen was chosen for further study. The following procedures were used: to liquefied Sabouraud's Peptone agar (Difco) was added sufficient crystalline 8 Methoxypsoralen to produce a concentration of one milligram per centimeter. Desired lesser concentrations were achieved by further dilution with liquefied agar. The addition of acetone solutions of 8 Methoxypsoralen was unsatisfactory since acetone apparently had fungicidal effects. It should be noted that autoclaving the 8 Methoxypsoralen also seriously diminished its anti-fungal activity. A saline suspension of mycelia, as previously described, was added to the liquefied agar (keeping the temperature below 55 F. to prevent killing of the fungi), and was mixed by swirling the flask. Ten cc. aliquots were poured into 10 cm. Petri dishes. After about one hour the plates were uncovered, a cardboard screen with a round, one inch aperture was interposed, and the plate was irradiated with ultraviolet light. Variables included:

1. Concentration of 8 Methoxypsoralen
2. Intensity of the ultraviolet source
3. Spectrum of the ultraviolet source
4. Distance from ultraviolet source
5. Time of exposure

Table 1

Compound	E. Flocculosum	M. Canis	M. Gypseum	Tr. Mentagrophytes	T. Rubrum
Psoralen	10 mm.	18 mm.	20 mm.	20 mm.	25 mm.
8 Methoxypsoralen	14 mm.	20 mm.	20 mm.	10 mm.	18 mm.
5 Methoxypsoralen	18 mm.	14 mm.	15 mm.	13 mm.	23 mm.
5 Methyl Psoralen	18 mm.	15 mm.	17 mm.	11 mm.	13 mm.
Trimethyl Psoralen	23 mm.	17 mm.	14 mm.	11 mm.	16 mm.
Thio-coumarin	8 mm.	12 mm.	12 mm.	0	0

(Zones of inhibition in millimeters)

Psoralen Quinone showed anti-fungal activity against all organisms tested, which was neither enhanced or vitiated by irradiation.

Thio-coumarin showed anti-fungal activity unaffected by irradiation against Epidermophyton Flocculosum and Microsporum Gypseum.

The following compounds were tested and showed no demonstrable photosensitizing effects against any of the organisms used: Isopimpinellin, 5 Mitro 8 Methoxypsoralen, 2 Thio 8 Methoxypsoralen, Coumarin, 7 Hydroxycoumarin, Vlsnagin, Khellin, 3 Chlorocoumarin.

The non-irradiated area of each plate served as a control. Control plates exposed to the Kromayer ultraviolet, but with no drug added, revealed that this ultraviolet lamp alone had no discernible effect on these five organisms. The results are shown in tables 2, 3, 4 and figure 2.

It would appear that time of exposure is of greater importance than is drug concentration. Attempts were made to find the minimum effective drug concentrations and minimum effective ultraviolet light exposures, but without success.

Table 2: Time of Exposure Versus Drug Concentration of *Microsporum Gypseum*

Concentration	Exposure Time	Inhibition Zone
.1 mg. %	1 sec.	0
	5 secs.	11 mm.
	10 secs.	22 mm.
.5 mg. %	1 sec.	0
	5 secs.	Irregular
	10 secs.	25 mm.
1.0 mg. %	1 sec.	0
	5 secs.	18 mm.
	10 secs.	25 mm.
5.0 mg. %	1 sec.	0
	5 secs.	30 mm.
	10 secs.	35 mm.

The fungi do not lend themselves to progressive dilution technics as do bacteria, and the end points of the lethal effects are not sharply demarcated. Gross analysis suggests that effective concentrations of drugs begin at one milligram per cent against *Microsporum Gypseum*, but against all organisms, 8 Methoxy-psoralen is not consistently effective below .5 mg. per cent. Exposures to

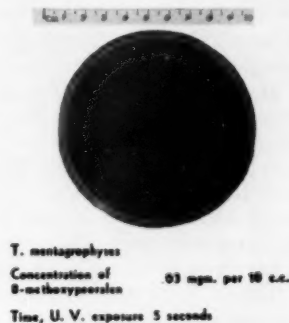


Fig. 2

Table 3: Effects on *Trichophyton Mentagrophytes* and *Microsporum Gypseum* with 8 Methoxypsoralen and Air Cooled Kromayer Lamp at Six Inches Distance and 144 Hours Incubation

Time of Exposure	M. Gypseum	T. Mentagrophytes
5 secs.	0	20 mm. (slight inhibition visible)
10 secs.	0	20 mm. (moderate inhibition visible)
15 secs.	0	20 mm. (marked inhibition visible)
30 secs.	20 mm. (total kill)	20 mm. (total kill)

Table 4: Comparison of Kromayer Air Cooled Lamp Versus the Glo-Craft No. 70 with .5 mg. % 8 Methoxypsoralen Against Three Organisms

Organism	Kromayer		Glo-Craft No. 70	
	Time	Zone of Inhibition	Time	Zone of Inhibition
<i>Microsporum Gypseum</i>	10 sec.	25 mm.	10 min.	10 mm.
	15 sec.	18 mm.	15 min.	15 mm.
	20 sec.	20 mm.	20 min.	20 mm.
	25 sec.	20 mm.		
<i>T. Mentagrophytes</i>	10 sec.	25 mm.	10 min.	10 mm.
	15 sec.	25 mm.	15 min.	15 mm.
	20 sec.	22 mm.	20 min.	20 mm.
	25 sec.	25 mm.		
<i>Microsporum Canis</i>	10 sec.	25 mm.	10 min.	15 mm.
	15 sec.	25 mm.	15 min.	10 mm.
	20 sec.	25 mm.		
	25 sec.	20 mm.		

air-cooled Kromayer lamp of less than five seconds were unpredictable.

Trichophyton Mentagrophytes is more sensitive to the method than Microsporum Gypseum. The effects on Trichophyton Mentagrophytes demonstrate the gentle slope of the lethal curve. Increasing lamp-to-plate distance sharply diminishes the lethal effect. The inverse square rule of light intensity does not operate here, however, since the generating tube is not a point source.

Although irregularities appear which we feel are due to the inherent variabilities of fungal plate growth, this indicates an effective output of the Kromayer lamp at 30 to 50 times that of the Glo-Craft. The Glo-Craft has been calibrated on a ferric-ferrous reduction actinometer.⁴ Similar figures are not available for the Kromayer lamp. The Glo-Craft lamp has its principal output at 3654 Angstrom units, while the Kromayer has a very broad spectrum, ranging from 1850 to 4000 Angstrom units. A trial against a standard laboratory strain of Micrococcus aureus after the technic used by Fowlks, Griffith and Oginsky,¹ but interposing $\frac{3}{16}$ inch window glass, indicates that the active portion of the spectrum is longer than 3100 Angstrom units. Further experiments with monochromatic filters are planned in the hopes of determining which portions of the ultraviolet spectrum are responsible for the photosensitizing phenomena.

III. Investigation of Effects on Spores

Spore forms of most fungi are more resistant to noxious substances and conditions than are the mycelial elements. It was desirable to determine whether or not the photosensitization phenomena were effective in killing spores. The following procedure was used to obviate bacterial overgrowth: all agar was autoclaved prior to the addition of the 8 Methoxypsoralen. The agar and drug were combined by passing the 8 Methoxypsoralen in acetone solution through a Seitz filter, evaporating to dryness, and then adding melted agar. In addition, several plates of each species were prepared so that if bacterial contamination

occurred, at least some plates would remain free of such contamination. The 8 Methoxypsoralen agar suspension of one milligram per cent strength was prepared as previously described. Scrapings from colonies of all five organisms several weeks old wherein spores had already formed, as determined by direct microscopic examination, were prepared and added to the agar as in previous experiments. Small pools of the resulting agar suspension were then placed in Petri dishes and exposed to 15 seconds of air-cooled Kromayer lamp at two inches distance. Controls prepared identically, but not irradiated, were kept until growth appeared, indicating the presence of visible organisms. The plates were sealed with tape and incubated at room temperature. Spores would be expected to activate within six to eight weeks in all of these species. None of the irradiated plates showed any growth after 10 weeks of incubation. Unless some other factors which are noxious to the spores are acting here, we feel that the spores are effectively inactivated by the photosensitizing procedure.

Discussion

The lethal event to an organism is presumed to require: (1) sufficiency of photosensitizing molecules, possibly adsorbed on the surface of the cell and (2) sufficient quanta of incident ultraviolet light. The compound concentrations tested, and the ultraviolet exposures used lie within the limits of proven human tolerance.³

Summary

A variety of furocoumarins have been shown to have photosensitizing effects on several common dermatophytes. Irradiation of such sensitized organisms with ultraviolet light has been shown to be lethal to the spores of these organisms. The tested organisms commonly affect human skin at depths attainable by common ultraviolet sources, and furthermore, they might be expected to be affected by topical application of the compound. Eight Methoxypsoralen, a readily available compound, has been

found to be as effective against the tested organisms as any other compound used.

Conclusions

Photosensitization of several common dermatophytic fungi with 8 Methoxypsoralen, followed by irradiation by ultraviolet has been shown to have effective fungicidal activity in vitro, and this work is now under active clinical investigation.

Acknowledgment: The authors are grateful to the Department of Dermatology of the University of Oregon Medical School for providing drugs, use of equipment and assistance. These were provided in part through Public Health Service Grant CY-2837(C3).

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Information relative to securing reprints of this study may be had by checking the Reader Service column on page iv of this issue.



* new apparatus *

Carbon Dioxide Actuated Clamp For Quadriplegic Bladder Training

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and
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Los Angeles

● Another remotely controlled bladder training device is presented which is very adaptable for use in bed, wheelchair or on a gurney, especially for those quadriplegics who have absolutely no voluntary motion of the upper extremities. Its usefulness is self-evident for the tetraplegic who has retained some motion.

A variety of self-managed bladder training devices for quadriplegic patients has been described in the literature¹⁻³; however, none of these could

be easily operated by a patient who has not retained the slightest trace of volitional motion in the upper extremities.

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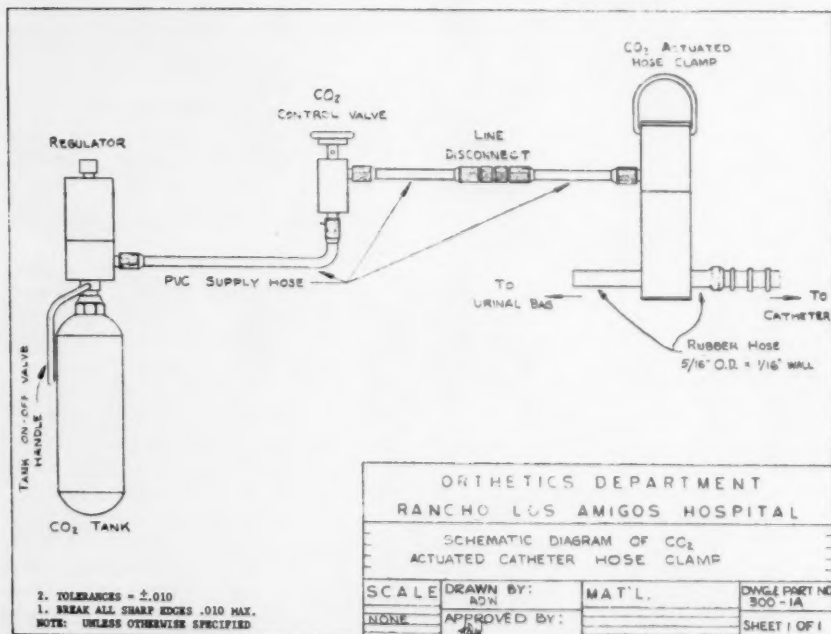


Fig. 1 — Schematic Diagram of Integral Parts of the Carbon Dioxide activated tubing clamp.



Fig. 2 — Photograph showing the device. It can be more easily adjusted when the patient goes from bed to wheelchair and vice versa because of the plastic tubing.



Fig. 3 — The photograph indicates how simply the device operates by pressure from the elbow.



Fig. 4 — Close-up view of figure 3.

Another shortcoming of one of the published apparatuses² was the fact that it was difficult to adjust when the patient was transferred from the wheelchair to the bed and vice versa.

After observing the performance of carbon dioxide tanks as muscle replacing aids for patients who became quadriplegic following anterior poliomyelitis, one of the authors (R. S.) was asked to use this principle on a clamp device for bladder training.

The carbon dioxide activated clamp has the following advantages: (1) the device can be readily adjusted owing to the plastic tubing when the position of the patient is changed; (2) the control valve is so sensitive that it can be adjusted to respond to any pressure between one ounce and one pound, and (3) it can be used even by tetraplegic patients without any voluntary motion of the upper extremities by merely pressing the face or head against the control valve.

The integral parts of the device are shown in figures 1 to 4.

Summary

Another remotely controlled bladder training device is presented which is very adaptable for use in a bed, a wheelchair or on a guerney, especially for those quadriplegics who have absolutely no voluntary motion of the upper extremities. Its usefulness is self-evident for the tetraplegic who has retained some motion.

References

1. Comarr, A. E.: Self-Managed Bladder Training Device For Tetraplegics. *J. Urol.* 76:200 (Aug.) 1956
2. Comarr, A. E.: Another Self-Managed Bladder Training Device for Tetraplegics. *J. Urol.* 78:89 (July) 1957
3. Sullivan, F. J., and Bors, E.: Self-Help device for Bladder Training of Tetraplegic Patients. *J. Urol.* 84:431 (Aug.) 1960.



★ survey of selected literature ★

This systematic abstracting and indexing of selected journals is made possible by a grant from the American Rehabilitation Foundation, a subsidiary of the Kenny Rehabilitation Institute.

AMERICAN JOURNAL OF THE MEDICAL SCIENCES. Vol. 240, Nov. 1960.

◇ Normal Protein Bound Iodine Values in Hyperthyroidism and Cretinism. N. G. Scheen-berg. pp. 552-560.

In recent years estimation of the concentration of protein bound iodine in the serum has become widely used as an indication of thyroid function. The present paper deals with clinically proved cases of hyperthyroidism and cretinism which yielded normal values of PBI. Various authors give 5.0 to 5.8 micrograms of PBI per 100 ml. of serum as the average in euthyroid subjects. Ninety-five per cent of euthyroid subjects yield values between about 3.0 and 7.6 micrograms PBI per 100 ml. of serum. In hyperthyroidism results quoted from the literature indicate that 2.3 to 12 per cent of these cases yield PBI values within the normal range. The author presents data on 15 of his hyperthyroid patients and on four of his hypothyroid cases that produced PBI values within normal limits. He emphasizes that diagnosis of malfunction of the thyroid should not be made solely on the basis of serum levels of PBI.

◇ Clinical Versus Actuarial Prediction in the Differential Diagnosis of Jaundice. W. M. Martin; P. C. Apostalakis, and H. Roazen. pp. 571-578.

This paper reports a comparison of the accuracy of diagnosis achieved by a group of physicians on the one hand and by a statistical formula on the other. It reaches at an investigation of so-called computer diagnosis. Two broad clinical entities were studied: parenchymal and obstructive jaundice. Forty-eight protocols were prepared including 23 cases of extrahepatic biliary obstruction and 25 cases of parenchymal liver disease. Twenty-four physicians classified each of the cases into these two main categories on the basis of hospital records. The protocols listed all historical information, all laboratory findings and the results of all x-ray studies. The actuarial predictions were based on two liver function tests: the Hanger cephalin cholesterol flocculation test (48 hour) and the Maclagen thymol turbidity test. The results showed that for the entire group of physicians an average of 82.3 per cent correct diagnoses was made. The formula correctly predicted 79.2 per cent of the cases. Among the 24 physicians, comprising interns, specialists and general practitioners, the specialists were most accurate averaging 86.6 per cent while the general practitioners were least accurate with an average of 78.2 per cent correct diagnoses. There was no statistical difference in the accuracy of the entire physician group versus the actuarial procedure.

Progress of medical science section: Radiology - roentgenographic manifestations of the cartilaginous dysplasias. Lane, J. W. p. 636.

★ AMERICAN JOURNAL OF THE MEDICAL SCIENCES. Vol. 240, Dec. 1960.

◇ Emotional Stress and Coronary Heart Disease in American Physicians. H. I. Russek. pp. 711-721.

In order to study the effect of occupational stress on the incidence of coronary heart disease, the author studied four groups of physicians. The groups were general practitioners, anesthesiologists, dermatologists and pathologists. Physicians in the first two groups were assumed by

the author to have a high degree of occupational stress while dermatologists and pathologists were assumed to have a low degree of working stress. This opinion was concurred in by an independent team of judges. Questionnaires were sent to 1000 randomly selected physicians in each of these specialties. The rate of response was 65 per cent. Seventy-one per cent of the answered questionnaires were used in the study. It was found that in the 40-69 year age group, the following percentages of each group had clinical coronary disease: Dermatologists - 3.2 per cent, Pathologists - 4.1 per cent, Anesthesiologists - 8.9 per cent, and General Practitioners - 11.9 per cent. A similar trend was apparent in each decade age group within the total range. The one exception was the reversal of the relative position of anesthesiologists and general practitioners in the 50-59 and the 60-69 year groups. The author concludes that this study gives added support to the concept that emotional strain is an important factor in the incidence of coronary disease.

◇ Penicillin - Oral or Intramuscular? G. A. Cronk, and W. R. Wheatley. pp. 722-725.

The work reported was designed to determine the difference in blood levels of penicillin obtained after administration of the drug by oral and intramuscular routes. Three antibiotic preparations were used: (1) an oral tablet containing 250 mg. of potassium phenethicillin (potassium alpha-phenoxyethyl penicillin); (2) an intramuscular solution containing 250 mg. of potassium penicillin G, and (3) an intramuscular solution containing 250 mg. of potassium phenethicillin. Two crossover experiments were performed on 10 healthy adult volunteers each comparing oral penicillin with intramuscular penicillin G. A Latin square experiment was carried out on 15 volunteer subjects using all three drug formulations. The crossover experiments demonstrated similar blood concentrations in samples collected at $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4 hours after drug administration. The average serum concentrations were plotted versus time after administration for the third experiment. Statistically identical curves were obtained. The conclusion is that essentially the same blood levels of penicillin were obtained after either route of administration. The results belie the common belief that higher blood levels are secured after administration via the intramuscular route.

The continuous association of poverty with intensity of rheumatic manifestations. Coburn, A. F. p. 687.



AMERICAN JOURNAL OF PHYSIOLOGY. Vol. 199, Dec. 1960.

◇ Direct Measurement of Blood Pressures in Minute Vessels of the Liver. K. Nakata; G. F. Leong, and R. W. Brauer. pp. 1181-1188.

This study was carried out to elucidate some of the previously obscure factors relating to hepatic hemodynamics. The technic of microcannulation under transillumination was used. The liver of 70-100 gm. mice was exposed under deep anesthesia. With due attention to surface dehydration, and with the animal supported in a special metal frame, the border of the left lateral lobe was transilluminated. Glass microneedles 10-15 microns in diameter were used as cannulas for pressure measurements in various small vessels. Considerable information is given regarding the details of technic. No measurements were possible in branches of the hepatic artery central to the point at which portal vein blood mixes with arterial blood. In the transilluminated portion of the liver, none of these parent arterial vessels were present. The pressures measured were mesenteric vein and portal vein - 12.7 cm. of water; sinusoidal level (portal venules) - 6.8 cm. of water; hepatic venules (smallest branches) - 2.3 cm. of water, and inferior vena cava - 2.4 to 4.4 cm. of water depending on the point at which the measurements were made. The principal pressure gradient in the liver exists between the portal venules and the small central vein (hepatic venule) 40-60 microns in diameter. An anomalous pressure gradient was observed between central vein and inferior vena cava. The influence of respiratory excursions in the latter pressure and vena cava flow is emphasized. The influence of fluid velocity in the vena cava on these pressures is not considered. The large pressure gradient observed between portal venules and central veins points to this region as the critical site for the regulation of hepatic parenchymal blood flow.

◇ Effects of Acute Transitory Urinary Obstruction in the Dog. J. R. Jaenike, and G. A. Bray. pp. 1219-1222.

Clinical reports had indicated a defect in the urine concentrating ability of kidneys in which acute ureteral obstruction had occurred. Acute ureteral obstruction forms a basic technic in the currently popular stop-flow technic for the study of kidney function. These authors have performed controlled experiments in dogs designed to determine the effects on osmolality and

solute excretion of kidneys subjected to acute transient ureteral obstruction. Under anesthesia both ureters were cannulated for urine collection. Using one kidney as a control, the ureter from the experimental kidney was obstructed by retrograde injection of one of several liquids (isotonic saline, urine previously excreted or mineral oil). The hydrostatic pressure was thus raised to 100-200 mm. Hg for a period of five to six minutes. Following release of the obstruction and after a delay of five to eight minutes for washout of the affected pelvis and ureter, urine samples were serially collected and analyzed. At the conclusion of the experiment the kidneys were removed for microscopic examination. Although total solute excretion was not impaired a consistent and persistent failure to produce urine as concentrated as that of the control kidney was observed. As yet the underlying reasons for this defect are obscure. However, as the authors point out, it must be borne in mind that the stop-flow technic probably produces function impaired in this way.

Body glucose as fuel for thermogenesis in the white rat exposed to cold. *Depocas, F., and R. Masironi. p. 1051.*

Respiration of epithelial component of mammary gland slices. *Rees, E. D. p. 1067.*

Cross circulation at the small blood vessel level in the dog paw. *Davis, D. L., and W. F. Hamilton. p. 1169.*



ARCHIVES OF NEUROLOGY. Vol. 3, Nov. 1960.

◇ **Occlusive Vascular Disease in the Extracranial Cerebral Circulation.** *M. J. Martin; J. P. Whismant, and G. P. Sayre. pp. 530-538.*

This paper is an attempt at studying the pathology of occlusive vascular disease in the extracranial carotid and vertebral arteries. A review of the literature is presented describing the earlier necropsy studies of occlusive disease of the extracranial cerebral circulation emphasizing the atherosclerotic narrowing in the carotid system: In this presentation, 100 unselected patients over 50 years of age were studied at necropsy to determine the pathological changes in the extracranial carotid and vertebral arteries, the aortic arch, and its branches with their ostia. Histologic sections were obtained in addition to a gross quantitation of the degree of atherosclerosis through measurement. The maximal degree of atherosclerosis was found in the carotid sinuses and proximal two centimeters of the internal carotid arteries; the common carotid arteries were also usually involved. Changes did appear in the other sites studied, but less frequently. In each of the 100 cases there was gross evidence of atherosclerosis. In 11 cases at least one artery supplying the brain was completely occluded and in nine of these cases the occlusion was multiple. Forty per cent of the cases studied demonstrated either occlusion or stenosis of over half of the lumen of at least one of the cervical carotids, the vertebrals, or their ostia. The only pathological change noted histologically was degenerative arteriopathy of the atherosclerotic type. The incidence of severe atherosclerosis correlated well with hypertension and with an increased incidence of myocardial infarctions. This correlation was less striking with cerebral atherosclerosis, as the severity of involvement of the cervical arteries exceeded the severity in the intracranial arteries in 93 per cent of the cases. Six of the nine cases of multiple occlusion had no central nervous system symptoms directly attributable to focal cerebral ischemia. There is, therefore, not a good correlation between the degree of arterial stenosis and the degree of impairment of cerebral function distal to the stenosis, due to an adequate collateral circulation.

◇ **Cerebrovascular Accidents in Patients Receiving Anticoagulant Drugs.** *C. E. Wells, and D. Urrea. pp. 553-557.*

An attempt is made to confirm clinically studies which showed that the administration of anticoagulants to dogs in close temporal association with the induction of cerebrovascular accidents significantly increased the hemorrhagic area of infarction and the mortality rate. A review of the literature for clinical evidence showed no definitive confirmatory consistency. The patients studied were those who had cerebral vascular accidents while receiving anticoagulants. The authors found 23 patients who had 26 accidents. Most of this number were receiving anticoagulation for cardiac disease. An assay of this number showed 14 instances of primary intracranial hemorrhage (including five subdural hematomas), nine of cerebral embolism, and three of cerebral thrombosis. Nineteen of these episodes occurred when the prothrombin time was above or within therapeutic range (20-40 sec.). The occurrence of five subdural hematomas suggested that relatively slight head trauma may lead to a subdural hematoma when

coagulability is reduced. Nine of the 26 episodes resulted in death. The overall mortality rate (35%) did not differ significantly from that in any untreated group, and the slightly higher mortality occurring when the prothrombin time was above therapeutic range was not statistically significant. Six of the nine deaths were in hypertensives, in five of whom intracranial hemorrhage took place. Therefore, the mortality rate is definitely higher in hypertensive patients undergoing anticoagulation than in normotensive patients. Eight of the nine deaths were due to hemorrhage. While the exact frequency of cerebral vascular accidents appearing during anticoagulation was not determined, the incidence of 26 episodes from among the large number of patients studied did not appear strikingly high.

Muscle spasm and abnormal postures resulting from damage to interneurons in spinal cord. Penry, J. K.; D. Hoefnagel; S. van der Noort, and D. Denny-Brown. p. 500.

Cerebral angiography in patients over fifty. Dobrak, A. H.; A. L. Beck, Jr.; T. J. Murphy, and J. G. Zoll. p. 582.



ARCHIVES OF NEUROLOGY. Vol. 4, Jan. 1961.

◇ **Reversible Block of Nerve Conduction by Ultrasound.** R. R. Young, and E. Henneman. pp. 83-89.

This study on peripheral nerves investigates the effects of focused ultrasound on axonal conduction in a mixed nerve. The sciatic nerve of the frog was used in the *in vitro* experimentation and the transducer was calibrated to deliver a constant intensity and pulse rate at a focal point. In each experiment the flux of ultrasound (pulse width x train length) was gradually increased to a level which would affect conduction of impulses. Action potentials following stimulation were recorded. Past work had shown that each deflection in the compound action potential of a mixed nerve corresponded to the conduction in a different group of nerve fibers (A: alpha, beta, gamma). Consequently, the reduction in amplitude caused by ultrasound indicated that fewer fibers were carrying impulses, and that therefore conduction had been blocked completely in some fibers. Pulse widths greater than 1 sec. and a train length of over 20 pulses will abolish conduction of impulses; whereas, pulse widths of less than 0.4 sec. and train lengths of less than 10 pulses will achieve no effect upon conduction. Between these ranges reversible blocks can occur. The time course of the reversible blocks varied from a few seconds to 10 minutes. As cumulative irradiation increased, the nerve fibers became more sensitive to ultrasound in terms of degree of blocking per pulse. The smaller fibers were more sensitive to ultrasound in that less ultrasound was required to block them, and their recovery after irradiation was less complete. Therefore, there seemed to be an inverse relationship between fiber size and sensitivity to ultrasound. However, the optimum conditions for producing differential effects are not known. Dosage parameters are pulse width; train length; pulse rate, and intensity. Application of this study to mammalian nerves with extension of the investigation to myelinated and to unmyelinated fibers, particularly those fibers which are believed to mediate pain impulses (the delta and C fibers), is suggested for future study.

Brain metastases. Strang, R., and C. A. Marsan. p. 8.

Tremor studies in normals and in parkinsonism. Wachs, H., and B. Boshes. p. 66.



BRITISH MEDICAL JOURNAL. Vol. 1, Jan. 1961.

◇ **A Comparison Between Epidural Anesthesia and Bed Rest in Sciatica.** E. N. Coomes. pp. 20-24.

Epidural anesthesia and bed rest are two widely accepted methods for the treatment of sciatica. It was the object of this paper to compare the results of these two methods. Two groups of 20 out-patients with sciatica were studied. All the patients included had nerve-root pressure with neurological signs in the affected leg. There was no significant difference in age, sex, duration of symptoms, or nerve-root level involvement in the two groups. Both groups of patients were seen at weekly intervals for examination. When pain had subsided, when the straight-leg raising was full or nearly so, and when the patients were able to walk normally they were designated as "cured" for the purpose of the investigation. The investigation revealed that epidural injection

was a better form of conservative treatment than bed rest. The mean time needed for the bed rest group to recover was 31 days; for the epidural group it was 11 days. Neurological improvement occurred in only five out of 20 in the bed rest group, whereas 12 out of 20 improved in the epidural group. No complications of epidural anesthesia were encountered except for transient dizziness and mild headache, lasting an hour or so at the most. Epidural anesthesia was considered a safe procedure for out-patients. In evaluating the two different treatments, the author also emphasizes the financial aspects. It is far more expensive for the patient to go to bed and remain away from work for at least a month, than it is to be treated by epidural injection as an out-patient, with relief of pain in about a third of the time.

◇ **Gout and the Hemoglobin Level in Patients with Cardiac and Respiratory Disease.** J. G. Lewis. pp. 24-26.

The author investigated the frequency of gout in patients with cardiac and respiratory disease who might be expected to have secondary polycythemia. Polycythemia was arbitrarily considered to be present when the hemoglobin was 120 per cent or more. Out of approximately 7,500 estimations of the hemoglobin concentration, 90 patients had a value of 120 per cent or over. Diagnosis of gout was made in four patients. In a group of 200 patients with cardiac or respiratory disease and with a hemoglobin level below 120 per cent, there were two patients with gout. The association of gout in patients with a high hemoglobin level was seen more often with cardiac than respiratory disease. The author points out the importance of recognizing the association of gout with cyanotic heart disease and distinguishing it from other causes of arthritis such as rheumatic fever, as well as from vascular thrombosis and the embolic manifestations of bacterial endocarditis.

◇ **Extent and Permanence of Denervation Produced by Lumbar Sympathectomy.** J. A. Gillespie. pp. 79-83.

This paper presents the results of a quantitative investigation into the early and late effects of sympathectomy on sudomotor activity. Thermoregulatory sweating is a sensitive index of recovery of sympathetic function. Sweating was determined by measurement of the electrical conductivity of the skin. As sweating depends on sympathetic activity, skin-conductivity measurements can be used to determine the extent of residual sympathetic activity after surgery. Sudomotor activity was investigated in 77 patients. The early changes resulting from operation were investigated in a number of patients by tests carried out at intervals up to one year after surgery. The long term effects were investigated in 75 patients by tests carried out between one and seven years after operation. Segmental return of sudomotor activity was the rule in the last thoracic and first lumbar dermatomes, and was common in the second and third lumbar dermatomes. Recovery of sweating was often as complete as it was by eight weeks, and there was never any marked change between the test at about five months and a later test at one year. Recovery thus apparently goes so far and then stops. Recovery seems to take place dermatome by dermatome from above downwards. The author discussed the reason for the recovery of sweating. It seemed to be due to the presence of residual sympathetic-nerve pathways which pass via so-called intermediate ganglia lying outside the paravertebral sympathetic chain and escape damage at operation. The practical implication of this recovery is that nothing is gained by removing the lower thoracic and upper lumbar ganglia at operation. Lumbar sympathectomy, apart from the effects of accidental re-routing, produces lasting sympathetic denervation of more distal dermatomes. Recovery of even slight sudomotor activity could be more often demonstrated than recovery of vasomotor activity in sympathectomized lower limbs. This, it was pointed out, illustrated the greater sensitivity of the skin-conductivity test in detecting the presence of minimal sympathetic activity postoperatively.

◇ **The Relief of Pain by Cooling of the Skin.** Maurice Ellis. pp. 250-252.

The author reported his nine years experience on the successful use of ethyl chloride spray in the treatment of various painful conditions. Number of patients treated was not given. Types of pain in which the spray gave dramatic and immediate relief include lumbago, acute wryneck, fibrositis, renal colic, dysmenorrhea and fractured rib. One can only speculate concerning the mechanism of relief. The author presented the theory that the spray acts by bombarding the central pain receptor area with such a barrage of cold impulses that the pain impulses are swamped and obliterated. When the sensation of pain is obliterated the reflex arc is broken and the motor impulses carrying muscle spasm stop. The treatment, in fact, can be said to be vigorous counterirritation. The technical points necessary for success were discussed. It was pointed out that spray should not be so prolonged that skin-freezing occurs, and should be stopped at the earliest suggestion of freezing.

Clinical aspects of cardiomyopathy. Goodwin, J. F.; H. Gordon; A. Hollman, and M. B. Bishop. p. 69.

Osteosclerotic bone changes in primary hyperparathyroidism with renal failure. Willis, M. R.; R. E. Richardson, and R. Gordon Paul. p. 252.



BRITISH MEDICAL JOURNAL. Vol. 1, Feb. 1961.

◇ **Prognosis and Survival in the Aftermath of Hemiplegia.** G. F. Adams, and J. D. Merrett. pp. 309-315.

The factors influencing prognosis and survival have been studied in a series of 736 patients with hemiplegia of vascular origin. Patients who recovered quickly from minor paresis or succumbed early in the course of the disease were excluded from this series. The rest, however, represent a relatively unselected group of hard-hit survivors of strokes. These were accepted for rehabilitation without reserve, in the belief that no patient who survives the onset of stroke should be denied an attempt at rehabilitation in the early weeks. Treatment was usually started two weeks or more after the stroke and continued as long as there was any sign of improvement, if necessary, for several months of in-patient and out-patient care. Patients were classified into three groups (1) Recovered: Those who recovered, achieving complete or almost complete independence; (2) Long-stay: Those who failed to respond to treatment becoming chairfast or bedfast and incapable of walking alone; (3) Died: Those who died within two months of onset. Eighty-one per cent of the patients survived these two months, but their chance of being able to get about and look after themselves was little better than that of becoming permanently incapacitated (42.3% compared with 38.5%). There were no significant differences between men and women in the grade of recovery. Age did not preclude a good recovery, but it did affect the stroke outcome. The average ages of men and women who died (73.8 and 72.5 years respectively) were greater than the average ages of those who became chronic invalids (70.8 and 70.3 years), who in turn were older than the recovered group (67.7 and 65.7 years). In the recovered group of patients there were higher proportions of men and women with lesions of the dominant hemisphere (62.7% and 58.5% respectively) than were found in either the long-stay group or among those who died. This difference was significant only for the men. For both sexes there was little difference in the proportion of left and right cerebral lesions in long-stay patients, but there were rather more right cerebral lesions among those who died within two months. The earlier physical retraining began the better, and, if successful, the recovered patient had an even chance of maintaining a relatively active life for at least six years if aged less than 65 at the onset, or for three and a half years if a man and four years if a woman over that age. Men and women who recovered lived longer than those who became long-stay patients. This was true of each age-group. The authors review the results of rehabilitation in hemiplegia reported in recent years, and compare the 42 per cent recovery rate in their series with other studies.

Acute bulbar poliomyelitis in late pregnancy. Wingate, M. B.; H. K. Meller, and G. Ormiston. p. 407.



GERIATRICS. Vol. 16, No. 2, Feb. 1961.

◇ **Osteoarthritis in Experimental Animals.** E. Silverstein. pp. 94-99.

Osteoarthritis has been noted in various avian and mammalian species. Spontaneous occurrence of the disease in laboratory animals has provided an opportunity for study of its processes under experimentally controlled conditions. Such investigation may afford further insight into the nature of osteoarthritis in humans. Recent experimental work with mice has shown the disease to be a localized process, with incidence and severity increasing with age, and also that genetic factors may determine the presence or absence of the disease. Additional factors include sex, hormonal influence, dietary and mechanical derangements. Osteoarthritis is more frequent in male than in female mice. Hormonal influences are not clear, but anterior pituitary extracts seem to accelerate the processes of osteoarthritis, and the incidence is diminished with administration of thyroxine. Male sex hormones appear to increase the incidence, whereas female and adrenal hormones tend to decrease the incidence of the disease. Obesity and high-fat diets also increase the incidence, probably acting through metabolic pathways not yet understood. It is hoped that further studies of this character will lead to complete understanding of etiologic and pathogenic factors in osteoarthritis, thereby affording more rational therapy and the possibility of prevention of the disease.



NEW ENGLAND JOURNAL OF MEDICINE. Vol. 264, Jan. 12, 1961.

◇ **Idiopathic Recurrent Rhabdomyolysis Associated with Myoglobinuria: Report of a Case.** T. A. Farmer, Jr.; W. J. Hammack, and W. B. Frommeyer, Jr. pp. 60-66.

In this report 48 cases of idiopathic rhabdomyolysis from the literature are reviewed. The symptoms of the disease are painful tender muscles associated with idiopathic myoglobinuria. The disorder occurred four times more frequently in the male than in the female. There was little predilection for any particular age group. Exercise as a precipitating factor was noted in a third of the patients. Renal failure occurred in approximately 30 per cent of the patients, and the mortality in the entire group approximates 20 per cent. Autopsy was performed in seven of the 10 fatal cases; and in each, muscle necrosis constituted the major abnormality noted. Berenbaum et al have calculated that visibly detectable myoglobinuria may occur after destruction of approximately 200 gm. of muscle. The etiology of the condition remains obscure. A case of idiopathic rhabdomyolysis is reported and methods of confirmation of diagnosis are reviewed and critically analyzed. Filter-paper electrophoresis and ultrafiltration of the urine during pigmenturia are the most specific and simple confirmatory tests in myoglobinuria. Reliance on the spectrophotometer alone is hazardous as well as unnecessary, and the specificity of the ammonium sulfate precipitation test needs further confirmation.

**NEW ENGLAND JOURNAL OF MEDICINE. Vol. 264, Feb. 16, 1961.**

◇ **Transmetatarsal Amputations and Arterial Surgery in Diabetic Patients.** F. C. Wheelock. pp. 316-320.

A large experience with amputation of the forefoot in diabetic patients with gangrene is reviewed. Certain requirements must be met if this procedure is to be successful; namely, a distally located lesion localized in a foot with adequate collateral circulation. Four hundred and twenty-eight such operations were performed before July, 1958. Sixty-three per cent were healed two or more years later. At the end of five years 46 per cent were still serving satisfactorily. Since 1952 diabetic patients with incapacitating claudication, ischemic rest pain or gangrene have been screened in the hope of finding patients with localized artery blocks suitable for arterial reconstruction. Owing to the diffuseness of their arteriosclerosis, only 65 patients were found to be reasonable candidates and were operated on; 13 aortoiliac blocks were treated, and 52 blocks in the femoropopliteal area. Three patients died of cardiac and cerebrovascular problems after operation. Fifty-seven operations were initially successful, and 36 reconstructions stayed open either till the patient's subsequent death or to the present. The transmetatarsal amputation for distal gangrene of the foot has proved a valuable procedure and one responsible for the salvage of many legs. Arterial reconstruction in the diabetic patient is worth while when segmental occlusions in the aorta, iliac, femoral or upper popliteal arteries can be found.



The Survey of Selected Literature for August 1961 was prepared by

Richard W. Stow, Ph.D.	<i>for</i>	American Journal of the Medical Sciences
<i>Tehran, Iran</i>		American Journal of Physiology
John D. Guyton, M.D.	<i>for</i>	Archives of Neurology
<i>Worthington, Ohio</i>		
Oswaldo Miglietta, M.D.	<i>for</i>	British Medical Journal
<i>Astoria, N. Y.</i>		

Robert M. Wells, M.D. *for* Geriatrics
 Columbus, Ohio

Else A. Tophøj, M.D. *for* New England Journal of Medicine
 Odense, Denmark

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★ book reviews ★

CONTEMPORARY EQUIPMENT FOR WORK WITH RADIOACTIVE ISOTOPES. Translated from the Russian text. Paper. Price, \$15.00. Pp. 66, with illustrations. Consultants Bureau, Inc., 227 W. 17th St., New York 11, 1959.

This booklet contains a translation of a collection of reports by the Soviet scientists Bochkarev, Dedov, Iakovlev, Kulish and Tupitsyn. After an introductory discussion of some technological aspects of the production of radioisotopes and labeled compounds, the authors devote considerable space to the description of various remote handling methods for radioisotopes as used in the radiochemical laboratories of the Academy of Sciences of the USSR. These range from several types of mechanical holding devices to remote control pneumatic and hydro-manipulators and dispensers. A description of various methods of decontamination concludes the text. The methods presented do not seem to differ essentially from those used in other countries. Thirty-six illustrations, the half-tones of which are poorly reproduced, give an instructive picture of the quality of the mechanical work, which in some of the instruments shown, is of high order. Considering the small size of the booklet and the poor quality of the binding, the price is high. (*Otto Glasser, Ph.D.*)

GESCHICHTE DER ORTHOPADIE. By *Prof. Dr. B. Valentin*. Cloth. Price, \$9.45. Pp. 288, with illustrations. Georg Thieme Verlag, 14a Stuttgart, Herdweg 63, Germany, 1961.

The author of this interesting book realized some ten years ago that, with the possible exception of some minor reports, notably on the history of the treatment of scoliosis, there did not exist a comprehensive treatise on the history of orthopedics. He thereupon acquainted himself first with the methods used in investigating historical events in medicine in general and then worked diligently on the study of the history of orthopedics in such famous libraries as the Wellcome in London; the Niedersächsische Staats- und Universitäts-Bibliothek in Göttingen; the Académie Nationale de Médecine in Paris; the New York Academy of Medicine, and many others.

The result of these efforts is a rather comprehensive, international and well-documented book on the history of orthopedics. It is divided into two main parts of equal length. The history of diagnosis and treatment of the most important orthopedic diseases is described in the first part of the book, starting with ancient Egypt, Hippocrates and Persia. The second part describes the development of orthopedics in England, France, Holland, Switzerland, Germany, Austria, Italy, United States of America and the Scandinavian countries. Short biographies of the most important orthopedists are added together with those of some lay people, notably orthopedic mechanics. One hundred forty-two excellent illustrations add greatly to the text. The printing is almost perfect. It is a delight to read and see the results of a thorough study of an important phase of medical history.

MANUAL OF CARE FOR THE DISABLED PATIENT. By *Arthur J. Heather, M.D.* Cloth. Price, \$3.75. The Macmillan Company, 60 Fifth Ave., New York 11, 1960.

This small and easy to read book helps to fill a gap in the literature on the everyday care of chronically ill and disabled people. While the specialist in restorative medicine will hardly find anything that would add to his knowledge, the general practitioner and specialists in other fields of medicine can obtain a good deal of applicable information.

It is quite obvious that the author was forced to make compromises in order to cover this large subject within the framework of a small monograph. One of our major comments is that the author found it difficult to create a balance between matters of greater and lesser importance. While the problems of prosthetics occupy one-fourth of the book, there is nothing written on such important subjects as braces and wheelchairs. On the other hand, the author goes into such details as specimen menus for the chronically ill patient. In such a short book, a discussion on dietary principles would have been adequate and valuable space gained could have been used to cover important subjects such as splinting, self-help devices, etc.

In spite of these omissions, this book contains so much information that it will offer

invaluable help to physicians, nurses, and others dealing with long-term patients. (*Michael M. Dacso, M.D.*)

KRANZ MANUAL OF KINESIOLOGY. Fourth Edition. By *Clem W. Thompson, Ph.D.* Paper. Price, \$3.75. Pp. 159, with illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1961.

I have reviewed an earlier edition of this book, and it has not improved with the passage of time. Its chief virtues are the excellence of the line drawings and its low cost. One excellent feature is a series of illustrations of the skeleton. These are at the end of the book and can be used by the student to color in the specific muscles he is studying.

The author's discussion of mechanics of motion is inadequate, and some of it is incorrect, e.g. the statement on page 123 that "acceleration (speed) determines force." Acceleration definitely is not equivalent to speed.

This book is not recommended for medical students or physical or occupational therapy students. It is perhaps adequate for physical education students and perhaps artists. (*Sedgwick Mead, M.D.*)

INTRODUCTION TO MEDICAL PHYSICS. By *J. Trygve Jensen, Ed.D.* Paper. Price, \$2.90. Pp. 240, with illustrations. J. B. Lippincott Company, E. Washington Square, Philadelphia 5, 1960.

The material for this introduction to medical physics was selected as a result of seven years' experience in teaching physics to registered nurses at Columbia University. Its emphasis is laid on the description of basic physical principles of various medical procedures. Although this book is elementary and practically free of mathematical formulas, it contains a large amount of information on such subjects as the underlying principles of body mechanics; the laws of gases and their effects upon the human body; mechanics of breathing; properties of liquids and their effects upon bladder irrigation and tidal drainage; heart and lung machines; regulation of body temperature; hearing and hearing aids; the eye and lenses; electricity and the human body; use of isotopes in medicine, and many more. In addition there are useful discussions on the scientific approach to biophysical problems and on the care required in making correct observations and measurements in medical physics. "A lost decimal point may mean the loss of a patient" quotes the author.

A few criticisms cannot detract from the value of the book as a whole. Slightly confusing is the selection of the same symbol as abbreviation for different physical entities. V,

for example, is used as a symbol for "volume of gas or liquid" as well as for "frequency of electromagnetic waves". Also, E is used to express "energy" as well as "electromotive force". Equally confusing is the attempt to explain the meaning of an isotope. If one talks about an isotope, for example the familiar I-131, then all the I-131 isotopes have, of course, the same atomic number and the same weight. On the other hand, if one speaks about isotopes in general, for example the isotopes I-130, I-131, I-132 and I-133, then these isotopes have all the same atomic number but different atomic weights. The bibliographies given in the book are rather limited and seem to have been selected with a special class of readers in mind. No mention is made of the three volume work *MEDICAL PHYSICS*, the first volume of which was published 15 years ago. The book is well-printed. The illustrations are selected with care. Some of them are drawn with real imagination. It is reasonably priced and can be recommended to all beginners in the field.

INSTRUCTIONAL COURSE LECTURES XVII: American Academy of Orthopaedic Surgeons. Edited by *Fred C. Reynolds, M.D.* Cloth. Price, \$18.50. Pp. 421, with illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1960.

This volume of the Instructional Course Series of the American Academy of Orthopaedic Surgeons compares favorably with previous volumes in the series as to content, presentation and format.

Presentations are grouped into five parts: fractures, bone graft surgery, children's orthopaedics, miscellaneous (including surgical approaches to the cervical spine and a symposium on disability evaluation), and athletic injuries.

Of particular interest to physiatrists are the chapters on disability evaluation and athletic injuries which contain a wealth of practical information. Management of the juvenile amputee is well covered from all standpoints, as is the subject of unequal leg length.

The volume is profusely illustrated and the format is excellent. It is to be recommended as a reference. (*Harriet E. Gillette, M.D.*)

MEANING AND METHODS OF DIAGNOSIS IN CLINICAL PSYCHIATRY. By *Thomas A. Loftus, M.D.* Cloth. Price, \$5.00. Pp. 169. Lea & Febiger, Washington Square, Philadelphia 6, 1960.

This book introduces originality and a non-conformist approach to the subject of psychiatric diagnoses. In the opening chapter, the author discusses the nature of "disease" in psychiatry and takes issue with the standard

nomenclature of psychiatric disorders (as formulated by the American Psychiatric Association) and criteria for their diagnoses. He claims that while this classification may be useful for statistical purposes, it is entirely inadequate for referential or "working" diagnoses. He discusses the meanings of "neurosis" and "psychosis" and classifies psychiatric illnesses in terms of six reaction types: neurotic, affective, schizophrenic, organic, that of the psychopathic personality and of mental deficiency.

In the chapter on psychiatric history-taking each section is illustrated with interwoven factual histories of two cases. The same technic is effectively applied for the psychiatric examination. The author suggests that the final formulation be reported in two forms—as a referential as well as a statistical diagnosis.

Psychiatric illnesses are discussed in a unique fashion. Four related disorders are presented concurrently in four columns under the same headings (such as, chief complaint, present illness, etc.). These are referred to as "comparative histories." The author lists the various designations under which the pathological conditions are described in the psychiatric literature.

A chapter is devoted to the psychiatric consultation, emergency consultation, doctor-patient relationship and the use of drugs in diagnosis. The author also included an interesting set of "exercises" for the student who is expected to identify the signs and symptoms given in the case history and to offer a diagnosis of the case.

While this reviewer cannot agree with some of the opinions expressed in this unique book, its author deserves credit for writing a diagnostic text that practically illustrates methods of history taking and of psychiatric examination.

The book should prove useful to the psychiatric student, especially if it is used as a supplement to a standard psychiatric text. (Jack Meislin, M.D.)

DISEASE AND INJURY. By Leopold Brahdy, M.D. Cloth. Price, \$12.50. Pp. 482. J. B. Lippincott Company, E. Washington Square, Philadelphia 5, 1961.

Dr. Brahdy has served as Physician-in-Charge, Occupational Diseases and Injuries, City of New York. As Editor, he is associated with 24 other persons in the preparation of this textbook. The volume is concerned with the relationship of single injuries to diseases which usually arise without injury. This is a first edition. Dr. Brahdy with the late Dr. Samuel Kahn published a similar type book, "Trauma and Disease", in 1937. "Disease and Injury" reflects continued interest, along with knowledge and experience that has been accumulated during the intervening years. Clin-

ical medicine and pathology are the sciences that are used as the basic elements to structure this work.

Mental disease; diabetes; heart disease, and peripheral vascular disease are discussed in relation to their etiology through injury. The gastrointestinal tract; the nervous system; the skeletal system; the thyroid, and the genitourinary tract are presented in a similar manner.

The relationship of articular disorders: neoplasms, and obstetrics and gynecology in relation to injury are also covered.

The book has few illustrations. Each chapter is followed by appropriate references. The editor and his contributors are distinguished individuals who are well qualified to cover the subjects that are assigned to them. The text is easy to read.

This book is of great value to every physician because of the extreme emphasis that is placed upon injury in our social system. It is certain to be consulted and quoted by members of the legal profession when they deal with the doctor of medicine in the Courts. The physiatrist will find this a particularly valuable book to have in his personal library. (Charles D. Shields, M.D.)

ELEMENTARY HUMAN PHYSIOLOGY.

By Terence A. Rogers, Ph.D. Cloth. Price, \$6.50. Pp. 417, with illustrations. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1961.

This new book has a novel arrangement, with a general outline of anatomy, histology, and chemistry; a section on the internal environment; a section on organs regulating and distributing the internal environment; the effectors and receptors, and a section on reproduction.

This is an unusually readable, concise, elementary human physiology text. It seems entirely appropriate for liberal arts undergraduates and also for a good many types of paramedical personnel, including physical therapists and occupational therapists. For nurses, social workers, and vocational counselors, as well as teachers in special education subjects, it might be better to have an even more elementary human physiology combined with elementary human anatomy. On the other hand this text could be used for such a purpose in conjunction with a brief anatomical atlas.

There is an ample index. No errors were found in the sporadic reading I did through the book. It is highly recommended for its limited purpose. (Sedgwick Mead, M.D.)

A SYNOPSIS OF CONTEMPORARY PSYCHIATRY. Second Edition. By *George A. Ulett, M.D., and D. Wells Goodrich, M.D.* Cloth. Price, \$6.50. Pp. 309, with illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1960.

This book "small enough to fit in the side pocket of the clinic coat" packs a wealth of useful quick reference psychiatric material. It is the equivalent of the medical intern's handbook. In addition to a historical introduction, this abbreviated text is organized into three parts: History Taking and Diagnostic Procedures, Clinical Syndromes, and Therapeutic Measures. The authors follow the official standard nomenclature of the American Psychiatric Association. The section on History Taking and Diagnostic Procedures includes a discussion of aphasia as well as chapters on electroencephalography and psychological examinations. It also contains a description of a number of the commonly used psychological tests.

The section entitled "Therapeutic Measures" contains tables dealing with the more popular tranquilizers and antidepressants. These tables offer such information as the name of the manufacturer, the chemical formula of the drug, form in which administered, dosage and side effects. It also includes a chapter on hydrotherapy. The authors discuss psychological first aid in civilian disasters, management of psychiatric problems in the military setting and forensic psychiatry. There is an extensive list of suggested readings and an adequate index.

This handy manual should prove to be most useful not only to the psychiatric residents but to other students of psychiatry. It also merits a place on the desk of the practicing clinician. (*Jack Meislin, M.D.*)

ANNUAL REVIEW OF MEDICINE. VOL. 12. Edited by *David A. Ryland, and William P. Creger.* Cloth. Price, \$7.00. Pp. 455. Annual Reviews, Inc., Palo Alto, Calif., 1961.

I have reviewed volumes in this series before. They have become a classic and should be on the bookshelf of every internist and many other specialists.

The articles on the Physiology of the Surgically Altered Stomach; Upward Reactions to Antimicrobial Agents; Oral Hypoglycemic Agents; Evaluation of Hazards of Radiation Exposure in Medical Practice; The Porphyrins and Porphyrins; and Psychiatry (Psychometrics) should be selected for complete reading.

Review writing is difficult, and the level of excellence in this series of chapters is very high. I was surprised to find that the article on Psychometrics was neither clear nor informative. The publication is highly recommended. (*Sedgwick Mead, M.D.*)

THE SCIENCE AND MEDICINE OF EXERCISE AND SPORTS. Edited by *Warren R. Johnson.* Cloth. Price, \$12.00. Pp. 740, with illustrations. Harper and Brothers, 49 E. 33rd St., New York 16, 1960.

The 36 chapters of this book are grouped into six parts which deal with the structural and mechanical; physiological; developmental (maturing and aging); psychological; cultural and historical, and the therapeutic aspects of exercises and sports. There is an introductory chapter entitled "The Spiral of Human Knowledge". A bibliography is included after each chapter. An index is devoted largely to the names of authors cited in the text.

The general impression given by the book is that of a leisurely, rather elegant presentation of the underlying philosophy, as distinguished from the circumstantial details, of physical play. It certainly does not represent the ultimate in either practical usefulness or critical analysis. An example of the meretricious guise in which platitudes can be decked out is the statement (p. 49) that "the mesomorphic individual is characterized by physical ruggedness and strength that, without question, are conducive to excellent physical performance". This means simply that people of the athletic type are more likely than very fat or very skinny people to make good athletes. The subject of physical measurements as means for predicting athletic competence was well discussed in a chapter in Dawson's textbook in 1935. Since that time the subject has been obnubilated, not clarified, by the introduction of the jargon of somatotyping. Perhaps it is time to apply more rigorous standards to material that is to be printed as scientific literature. The present book suffers from dilution by much that could have been omitted as unsettled, illogical, inconclusive, or ill-conceived. This is a pity because there is so much in it that is clear, interesting, and important. Perhaps the newest, and to many readers the most intriguing, material in the book is in the chapter on sport diving (i.e., underwater swimming). The book as a whole can be recommended as an attractive introduction to the subject and a valuable key to existing literature.

CLINICAL PSYCHIATRY. Second Edition. By *W. Mayer-Gross, M.D.; Eliot Slater, M.D., and Martin Roth, M.D.* Cloth. Price, \$13.00. Pp. 704, with illustrations. The Williams & Wilkins Company, Mt. Royal and Guilford Aves., Baltimore 2, 1960.

A British bookseller describes this text by his compatriots as "The most considerable textbook on psychiatry yet published in the English language". While such designation may be overzealous, this book offers an important contribution to the psychiatric literature.

ture and is likely to become a highly popular text and reference book in this country. It is a comprehensive volume with a great scope of material. There are many features which should prove attractive to the reader, including some illustrations. The introductory chapter contains a description of the various schools of psychiatry and the historical background of these disciplines. The relationship of the field of psychiatry to medicine, sociology, ecology and psychology is well presented. Space is given to Pavlovian Psychiatry and Existential Analysis.

The chapter dealing with examination of the psychiatric patient includes a detailed scheme for the evaluation of patients with brain tissue damage ("organic" cases). Of special interest to the internists is a discussion of Symptomatic Psychoses—psychiatric reactions that result from pathological somatic conditions. Presentation of mental disorders is well organized into subheadings such as definition; occurrence in the normal; physiological basis; associations (with other syndromes); predisposition; precipitation; theoretical views on causation; clinical features; differential diagnosis; course and prognosis, and treatment.

The textbook has separate chapters devoted to aging and the mental diseases of the aged, child psychiatry, and administrative and legal psychiatry. It is regrettable that this otherwise comprehensive text lacks a discussion of mental mechanisms and does not include an official classification of mental disorders. A prolific list of references and a detailed index provide easy access to needed information. In the preface, the authors express hope that they have been successful in writing a text which will be helpful not only to the student, the general practitioner and the nonpsychiatric medical specialist but one which will be of service to the psychiatric consultant, for whom it will provide a source of reference. They succeeded in their objective. (Jack Meislin, M.D.)

TEACHING THE EDUCABLE MENTALLY RETARDED - PRACTICAL METHODS.

By Malinda Dean Garton, A.M. Cloth. Price, \$7.50. Pp. 233, with illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1961.

The author is a teacher who is engaged in teaching mentally retarded children at a state teachers college. She is also active in

preparing teachers for this purpose. Her manual is concerned with methods of assisting the mentally retarded child towards self-realization, social competence, economic efficiency and civic responsibility. The author discusses the characteristics of the educable mentally retarded child and develops in detail a curriculum along with the teaching technics. The three R's, Music and Art are covered in a very practical manner. The word educable is used to modify mentally retarded in the title and throughout the book. There is no great conflict however with the idea that all mentally retarded can be trained to some degree. Love and respect for the mentally retarded child by the teacher is quietly stressed. The author states that, "These children are very perceptive of false sentiments and quickly detect anyone who assumes superiority or who makes them an object of ridicule." There are areas in the book where it is obvious that medical rehabilitation and training methods are not too well understood. As an example, in the chapter on Spelling the following appears under a discussion of Children With Speech Difficulties, "Many mentally retarded children have speech difficulties which appear to be due to their lack of ability to observe. When they can be induced to look and listen, they begin to imitate and to speak correctly." This is oversimplification.

One cannot use this book without developing a deeper respect for the knowledge and ability that a teacher must possess and a higher regard for the special training that is needed by teachers who work with the handicapped. Everyone who is associated with mentally retarded children will profit from studying this book and it will improve the quality of whatever services they are privileged to render to these children. (Charles D. Shields, M.D.)

*Of the many things man can do
or make, here below, by far the
most momentous, wonderful
and worthy are the things
called books.*

— THOMAS CARLYLE

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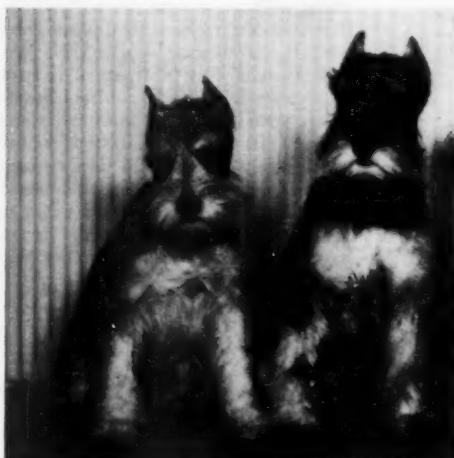
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1. Any subject of interest or pertaining to the field of physical medicine and rehabilitation may be submitted.
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5. The American Congress of Physical Medicine and Rehabilitation shall have the exclusive right to publish the winning essay in its official journal, the **ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION**.
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